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The Progressive Series

Questions in Anatomy,
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for

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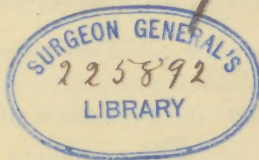
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PREFACE.

A practical Question and Answer Book should be comprehensive in scope without having too many and too detailed questions. It should furnish abundant material for drill, test, and review of the subject by means of well arranged and well graded questions, and should aim to cultivate in the student those qualities brought out in a good recitation by a skilled teacher.

With these objects in mind this series of books has been written. The separate books are intended, not only for beginners, but also for students pursuing advanced and review work. Care has been taken to make each book complete. The papers given at civil service, college entrance, and Regents examinations have been carefully culled for suitable questions, and the material arranged topically and logically to emphasize principles as well as essential facts. The answers are supported by the latest authorities and in consonance with the accepted texts for the best elementary and secondary schools. To make the work more helpful, diagrams, illustrations, maps, topical outlines, and glossaries have been included.

Acknowledgment is due to the many experienced teachers who have freely offered suggestions and criticisms designed to make this a most helpful "text-book."

The aim of the book is to present in brief, concise form the leading facts and principles in ANATOMY, PHYSIOLOGY, and HYGIENE through the medium of questions selected from a very large number of papers and answers based on reliable and authoritative sources. Technical terms have been very largely avoided, and a glossary following the questions supplies the large number of terms used in the leading texts. The main facts and principles and working rules of individual and public hygiene are presented in such a way that the teacher and student may enlarge on them.

To my son
LEONARD
whose questions
come from the mind
and the heart
this series is affectionately
DEDICATED

Questions in Anatomy, Physiology and Hygiene

THE BODY.

1. Define (a) anatomy, (b) physiology, and (c) hygiene.
2. Discuss the importance of studying (a) physiology, (b) hygiene.
3. What is the special value of hygiene to (a) the young, (b) the state?
4. What is a cell? Give the nature and construction of a cell.
5. Discuss the kinds of cells in the body. Where are they found?
6. What is a tissue? Classify tissues.
7. Define (a) organ, (b) systems. (c) How many systems in the body?
8. What is the best way to keep well?

FOODS.

9. What is the proportion of (a) water, (b) solid matter, in the body?
10. Name and classify the solid substances in the body, and tell the use and importance of each.
11. How can the mineral matter in the body be shown? Describe an experiment.
12. Name the five chief foodstuffs, or proximate principles.

13. (a) Define proteid. (b) Name three kinds of proteids, and tell where each is found.

14. State some facts about fat, its properties and uses.

15. (a) What is an oil? (b) Define emulsion. (c) Tell how to make an emulsion.

16. Of what use are carbohydrates?

17. Why should more carbohydrates and fats be eaten in winter than in summer?

18. Should a teacher eat the same kind of foods as the laborer? Give a reason for your answer.

19. Discuss the chemical composition of the body, naming the more important chemical elements entering into the composition of the various parts.

20. Why do we breathe faster when at hard work?

21. Why must one eat nitrogenous food?

22. (a) What is meant by food? (b) Show the need of the body for food.

23. Discuss the need of the body for (a) water and (b) mineral salts.

24. Discuss the quantity of food required by a person.

25. Give what you consider the ideal daily diet of an adult.

26. Assuming that the average weight of food consumed by a person during a day is about six and three-quarter pounds show what proportion of this amount should come from each of the three kingdoms.

27. Discuss the need for a mixed diet instead of a uniform diet.

28. Give a summary of diets and dietaries.

29. Why is milk to be regarded as the most perfect food?

30. Show the value of eggs as a food.

31. Show why meats form so important an article of diet.

32. Discuss cooking in the preparation of food as an essential for proper digestion.

33. What is the importance of fish as an article of food?

34. Discuss vegetable foods and their importance in a diet.

35. Why do grains, or cereals, form the most important article of food? Show that their ingredients are essential to life.

36. For what reasons are vegetables considered valuable articles of food?

37. Of what importance are fruits in a dietary?

38. Name the most important fluids and beverages consumed by the body.

39. Why is water essential to life?

40. Discuss coffee as a food.

41. Of what value is tea as a food?

42. In what respects do chocolate and cocoa have more of food value than tea and coffee?

43. (a) What is alcohol? (b) Enumerate the qualities of alcohol and show that alcohol is not a food.

44. Classify alcoholic drinks and beverages.

45. What is the value of tobacco as a food?

46. What is meant by ptomaine poisoning?

THE DIGESTIVE SYSTEM.

47. What is meant by digestion?

48. Name the parts of the digestive system, with their subdivisions.

49. Name the organs of mastication and swallowing.

50. What are (a) the mouth, (b) the palate?

51. (a) What is the tongue? Of what use is it? (b) How does the tongue indicate the general health of the individual?

52. Name the parts of a tooth.

53. (a) How many teeth has an adult? (b) What is the difference between the milk teeth and the permanent teeth?

54. Mention some facts regarding the appearing of the teeth.

55. Give some points on the care of the teeth.

56. Name the contents of the thorax or thoracic cavity.

57. Name the organs located in the abdominal cavity.

58. (a) What is the viscera? (b) What is the pleura?

(c) What is the peritoneum?

59. What are (a) the pharynx, (b) the esophagus?

60. (a) What is a tonsil? (b) Why is it necessary to remove the tonsils from some children?

61. What is a gland?

62. Name the glands assisting the process of digestion.

63. (a) Locate and describe the salivary glands, and tell what work they do. (b) Discuss the importance of thorough mastication. (c) Describe the taste buds.

64. (a) Locate the stomach. (b) Describe its functions fully. (c) Describe the movements of the stomach.

65. Name the muscles aiding the stomach in its work.

66. (a) Name and describe the glands found in the stomach. (b) Tell how the gastric juice is formed.

67. Locate and describe the intestines.

68. What is the vermiform appendix?

69. What are the intestinal glands?

70. (a) What is a ferment? (b) Where are the ferments produced?

71. Locate and describe the liver.
72. (a) Locate and describe the pancreas. (b) What is pancreatic juice, and its importance?
73. What are (a) chyme, (b) chyle?
74. Of what use is bile? Where is it found?
75. Why and how do the intestines move?
76. How is food absorbed from the intestines?
77. (a) What are the lacteals? What is their use?
(b) What is the thoracic duct?
78. Describe the portal system.
79. Discuss the absorption or passing of food through the intestinal walls.
80. Trace a mouthful of food through the complete process of digestion.
81. Where does the absorption of nutriment take place
(a) most, (b) least?
82. What are the evil effects of overeating?
83. Give a few points relating to the eating of food.
84. Name three foods requiring (a) the shortest time,
(b) the longest time for digestion.
85. What are the evil effects of the chewing of gum and of tobacco as regards digestion?
86. What are the evil effects of alcohol on the liver?
87. What are the evil effects of tight clothing on digestion?
88. (a) What are the villi? (b) What do the epithelial cells and the villi do?

THE CIRCULATORY SYSTEM.

89. (a) What is blood? (b) Describe its composition.

90. Describe fully (a) red corpuscles; (b) white corpuscles; (c) hemoglobin. Of what use is each?

91. (a) Where are red corpuscles formed? (b) How fast are they formed? (c) How are white corpuscles formed?

92. What is the nature and use of blood plasma?

93. What are the chief functions of the blood?

94. (a) Define coagulation. (b) To what is it due? (c) What is its importance?

95. Mention the gases carried along by the blood in its course around the body.

96. What are (a) blood serum, (b) fibrin?

97. What is lymph?

98. How much blood does the body contain?

99. Define anemia, and tell its relation to health.

100. (a) What is the difference between pure and impure blood? (b) How does arterial blood differ from venous blood?

101. State some facts in reference to bacteria in the blood.

102. (a) What is the spleen? (b) State the probable use of the spleen.

103. (a) What is the thyroid gland? (b) What is the function of this gland?

104. What is meant by the circulatory system?

105. (a) What is the heart? (b) Describe its location. (c) What is its function?

106. In what way do the cavities of the heart differ? Describe them.

107. What are (a) the pulmonary veins, (b) the aorta, (c) the pulmonary artery?

108. Describe fully the valves of the heart, naming them, and telling their function.

109. Explain fully how the heart works.

110. (a) What is meant by pulse? (b) How can the age of a person be partly told by the pulse? (c) What is the relation between illness and the pulse?

111. Discuss the relation between the heart and exercise.

112. Name four arteries and tell to what parts they lead the blood.

113. Name (a) the largest vein, and (b) the largest artery in the body.

114. Write a paragraph on the veins.

115. Explain why the large arteries lie deeper than the veins.

116. What is the connection between the heart and the lungs?

117. (a) What are capillaries? (b) What are their uses?

118. How are the blood vessels named?

119. (a) What are the lymphatics? (b) Describe the largest lymph vessel.

120. What causes the flow of lymph?

121. Describe the course of a drop of blood around the body.

122. What is the rate at which blood flows?

123. (a) What is a hemorrhage? (b) Tell how a hemorrhage may be stopped or checked.

124. Discuss the relation between exercise and the circulation of blood.

125. What is the effect of alcohol on the circulatory system? Discuss the question fully.

126. To whom do we owe the discovery of the circulation of blood?

127. What are the evil effects of smoking on the heart?

128. Briefly talk about heart disease. Give reasons why special care should be taken not to develop heart disease.

THE BONES AND THE SKELETON.

129. (a) What is bone? (b) Of what use are bones?

130. Give the composition of bone, and mention an experiment to show this.

131. Discuss the parts of a bone.

132. From what are bones developed?

133. (a) What is the skeleton? (b) What is the importance of the skeleton?

134. Name the (three) parts of the skeleton and the number of bones in each.

135. Give a table of the bones in the body.

136. Give a classification of bones according to their shape or form.

137. Explain why bones are hollow.

138. Discuss the difference between the bones of an adult and those of a child of five years of age.

139. Enumerate some properties of bone.

140. Classify and discuss cartilage.

141. Give a complete account of the development of bone.

142. What are (a) a fracture, (b) compound fracture, (c) a dislocation, (d) a strain, (e) a sprain?

143. Why should a heavy strain not be put upon the bones of the young? Show the relation of this to walking, to carrying bundles, etc.

144. Discuss the diseases of bones.
145. (a) What is the periosteum? (b) What is its purpose?
146. (a) What is the skull? (b) Name its parts.
147. Account for the shape of the bones of the skull.
148. What are the cranial sutures?
149. Name the bones of the upper extremities, and their number.
150. Name the parts of the lower extremities, and the number of bones in each.
151. In what way does the arrangement of the bones of the leg differ from that of the bones in the arm?
152. Name the bones of the trunk.
153. (a) What is the axis or spinal column? (b) Tell its importance. (c) Explain the structural arrangement of the spinal column.
154. (a) What are the dorsal bones? (b) How many in the spinal column? (c) What is their importance?
155. Name some important facts about the ribs, giving their construction, their number, and their use.
156. Describe fully the pelvic arch.
157. Enumerate some causes of curvature of the spine.
158. Explain the use of each of the following: (a) cartilage; (b) ligaments; (c) tendons. (d) What is the synovial membrane?
159. (a) What is a joint? (b) What is the difference between the movable and the immovable joints?
160. Name the four kinds of movable joints, telling where each may be found.
161. What are the various movements allowed by the different kinds of joints?
162. How should (a) a dislocation be treated? (b) a strain? (c) a fracture? (d) a sprain?

163. How do alcohol and narcotics affect bone growth and development?

164. Suggest some rules for erect posture.

165. Discuss the need of proper nourishment, rest, and exercise by the skeleton.

THE MUSCULAR SYSTEM.

166. (a) What are muscles? (b) What is their importance? (c) What special property is possessed by muscles?

167. What is the difference between (a) voluntary and (b) involuntary muscles?

168. Discuss the involuntary muscles.

169. Discuss the characteristics of a voluntary muscle.

170. Explain the meaning of (a) origin, (b) insertion, and (c) tendon. (d) What is the longest tendon?

171. Discuss the arrangement of the muscles. How many muscles in the body?

172. Name and describe the different kinds of muscles.

173. Why does the expression of the face depend upon the muscles?

174. Explain why the muscles should be exercised.

175. Name the principal muscles of the head.

176. Name the principal muscles of the trunk.

177. Enumerate those in the (a) upper and (b) lower extremities.

178. Explain how the muscles should be exercised.

179. Describe massaging, and its effects.

180. Mention several causes of muscular contractility.

181. What is the effect of tobacco on the muscles and muscular development?

182. How does alcohol affect the muscles?

THE RESPIRATORY SYSTEM.

183. (a) Define respiration. (b) What is the object of respiration?

184. Name the organs of respiration.

185. Describe fully the nasal passages, and tell their functions.

186. Describe the pharynx, telling of its special features.

187. What are the chief features of the larynx?

188. Describe the vocal cords.

189. (a) How is voice produced? (b) On what do loudness and quality of voice depend?

190. (a) Describe the trachea. (b) Explain how the air tubes end.

191. Describe the lungs.

192. Explain what is meant by the two kinds of respiration.

193. What causes the air to rush in and out of the lungs.

194. Explain how oxygen and carbonic acid gas exchange places in the lungs.

195. How is breathing regulated?

196. Give a few facts concerning the capacity of the lungs. Tell how the lung capacity is measured.

197. Name three diseases of the lung.

198. How does clothing affect breathing?

199. Define (a) sneezing (b) hiccoughing, (c) coughing, (d) whistling, (e) snoring.

200. To what may shortness of breath be due?

201. What is the connection between ventilation and good breathing? How much fresh air should be allowed to each person in a sleeping room?

202. Describe artificial breathing. Tell how it may be produced.

203. Discuss the relation between exercise and the lungs. How may the lungs be exercised?

204. Mention five facts concerning diseases of the respiratory system.

205. Tell about the adenoids.

206. How does alcohol affect the respiratory system?

207. In what way does tobacco harm the respiratory system?

208. Describe briefly some lung exercises.

209. What is the composition of air?

210. (a) What is the source of the air? (b) How can it be shown that plants give off oxygen?

211. Discuss the impurities of the air.

212. What is foul air?

213. Write about night air.

214. Write about mountain and seashore air.

215. What is meant by ventilation?

216. Tell how a room should be ventilated.

217. Discuss the subject of respired or exhaled air.

218. By means of what experiment can it be shown that carbonic acid gas is exhaled from the body?

219. Give the relative proportions of carbon dioxid in the air under different conditions.

220. What are the evil effects of impure air?

THE EXCRETORY SYSTEM.

221. What is meant by waste or excretions?

222. What are the kidneys?

223. Describe how the kidneys work.

224. Explain the effect of (a) water, (b) alcohol on the kidneys.

225. Describe the structure of the skin.

226. What are the uses of the skin?

227. Discuss the skin as (a) a protection and (b) an organ of sensation.

228. Discuss the skin as (a) an excretory organ, and (b) as regards the regulation of bodily temperature.

229. Discuss the remaining functions of the skin.

230. What senses reside in the skin?

231. Write about injuries to the skin.

232. Describe the sweat glands, and tell their special use.

233. Describe the sebaceous, or oil glands.

234. Describe the hair.

235. What are (a) baldness, (b) dandruff? (c) Give some cure for dandruff and baldness.

236. Tell what is meant by (a) the complexion, (b) its service as an indication of health, (c) how it may be improved.

237. Tell about the nails and what they are.

238. Discuss the merits of (a) the hot bath and (b) the cold bath.

239. Discuss the use of cosmetics and dyes.

240. Show the connection between clothing and health, particularly as affecting the skin.

241. Discuss the texture and color of clothing.

242. Discuss the use of the various textiles for clothing.

243. Show the relation of textile and color to absorption of the sun's heat.

244. What is the relation between health of the skin and alcohol?

THE NERVOUS SYSTEM.

245. What is the importance of the nervous system?
246. Name the parts of the nervous system.
247. What is the relation of the brain and the spinal cord to the rest of the body?
248. Describe the brain, naming its parts, its structure, and its importance.
249. Describe the cerebrum.
250. Describe the cerebellum.
251. What is the medulla oblongata?
252. What is the cortex of the brain?
253. Discuss the connection between the brain and the formation of habits.
254. (a) What part of a neuron composes the gray matter of the brain? (b) Explain axon. (c) What is a commissure?
255. Give the size, construction, and location of the spinal cord.
256. Define and discuss decussation.
257. Name the kinds of nerves. How does a sensory nerve differ from a motor nerve?
258. What are ganglia?
259. Describe what is meant by reflex action.
260. When are reflex actions noticed by the persons in whom they occur?
261. Describe the sympathetic nerve system.
262. What is the use of the sympathetic system?
263. Discuss the reflex actions of the brain.
264. Describe the functions of the cerebellum.

- 265. What is the importance of the cerebrum?
- 266. Describe the functions of the spinal cord.
- 267. Describe the direction of the fibers of the spinal cord.
- 268. What are the uses of the nerve centers?
- 269. Describe the spinal nerves.
- 270. Name the cranial nerves.
- 271. Explain fully how the brain acts.
- 272. (a) What is paralysis? (b) How does apoplexy differ from paralysis?
- 273. Tell how the uses of the brain have been determined.
- 274. Discuss the relation between brain weight and intellect.
- 275. Does the brain need exercise? Why? What kind of exercise?
- 276. Explain the relation between the nervous system and sleep.
- 277. What is meant by unconscious cerebration?
- 278. Discuss the harmful effects of tobacco on the nervous system.
- 279. How do alcoholic liquors affect the nervous system?
- 280. How do narcotics affect the nervous system?

THE SENSES AND THEIR ORGANS.

- 281. Name the two kinds of senses.
- 282. Name the special senses and their organs.
- 283. Discuss the senses of the skin.
- 284. (a) Where is the sense of taste located? (b) In what form must foods be to arouse the sense of taste?
- 285. Discuss the sense of smell, giving the location and formation of the organs.

286. (a) Give the location of the eye. (b) How is the eyeball moved?

287. Describe the eye. Draw a diagram, and on it mark the various parts.

288. How is the eye protected?

289. Name the parts of the eyeball coats.

290. (a) Describe the retina. What are the (b) blind spot, (c) yellow spot?

291. Name the three humors.

292. Explain the nature of light.

293. With the aid of a diagram describe the process of seeing.

294. What is meant by (a) myopia, (b) hypermetropia, (c) astigmatism? (d) What is an emmetropic eye?

295. Explain fully how each of the above eye defects may be cured or remedied.

296. Give a few suggestions as to taking care of the eyes.

297. (a) What is color blindness? (b) Give a test for color blindness.

298. What is (a) cataract of the eye, (b) trachoma?

299. Explain how dirt or cinders may be removed from beneath the lid.

300. What are (a) transparent and (b) opaque objects?

301. What is the effect of narcotics and alcoholic liquors on the sense organs?

302. What are Snelling's test letters? Explain their use in testing the eyesight.

303. (a) What is the organ of the sense of hearing? (b) Name the three parts of ear. (c) Which is the most important? Why?

304. Describe the (a) outer, (b) middle, and (c) inner ear.

305. Explain fully how sound is heard.

306. Discuss the care of the ears.

307. What is meant by deafness? Give its cause.

308. How may the hearing be tested?

DISEASES.

309. What are (a) stimulants, (b) narcotics, (c) poisons?

310. Name the most frequently used narcotic drugs.

311. Tell what you can about opium.

312. Tell about morphine.

313. Write about coca and cocain.

314. Write about (a) chloroform and (b) ether.

315. What are (a) microbes, (b) bacteria, (c) germs, (d) mold, (e) parasites, (f) saphrophytes?

316. Define (a) cocci, (b) bacilli, (c) spirilla.

317. Explain how bacteria grow and multiply.

318. Discuss the useful bacteria.

319. What is the connection between bacteria and the preservation of foods?

320. What is the relation between bacteria and disease?

321. What is meant by disease?

322. What are (a) infectious, (b) contagious diseases?

323. To whom are we indebted for the discovery that infectious diseases are the result of germs?

324. Make a list of infectious diseases.

325. Make a list of the common infectious diseases and their periods of incubation.

326. What is the relation between milk and diseases?

327. What is the connection between alcoholism and diseases?

328. What is meant by prophylaxis?

329. Discuss the general methods of preventing infectious diseases.

330. Discuss the destroying of the causes of diseases as a means of prevention.

331. Define (a) disinfectant, (b) antiseptic, (c) germicide, (d) bactericide, (e) fungicide, (f) deodorizer, (g) vaccination.

332. Discuss disinfection and disinfectants.

333. Discuss the isolation of the sick

334. Tell some other steps taken to prevent the spread of disease.

335. Tell some facts about the disposal of sewage as a problem of health departments.

336. Tell something about the duties of the board of health.

337. Discuss the spreading of diseases, and illustrate.

338. What are (a) toxins, (b) antitoxins?

339. What is tuberculosis? Discuss the care of tubercular and tuberculous persons.

340. Discuss the relation between typhoid fever and the water supply.

FIRST AID IN ACCIDENTS.

341. Discuss and suggest the general and immediate treatment of accidents.

342. What is meant by the term shock?

343. Tell what can and should be done in cases of shock.

344. To what is fainting due?

345. What can be done to help recover consciousness in cases of faint.

346. What is vertigo?

347. Tell what should be done in cases of vertigo.

348. What is the means of stopping the flow of blood in a hemorrhage?

349. What is (a) a fracture? (b) a dislocation?

350. What can be done in cases of fracture?

351. What can be done in cases of dislocation?

352. What is to be done in case of a sprain?

353. State briefly what remedies are to be applied immediately in cases of burns and scalds.

354. What is asphyxiation?

355. Tell what should be done in cases of asphyxiation from or by illuminating gas.

356. What should be done in cases of frost-bite?

357. Tell what should be done in cases of sunstroke.

358. What can be done to relieve cases of fits or convulsions?

359. Tell what should be done in cases of drowning.

360. (a) What is a poison?

(b) Give the steps in all treatment of poisoning.

TYPICAL EXAMINATION PAPERS.

361. State the changes that take place in the composition of the blood as it passes (a) through the muscles, (b) through the villi, (c) through the kidneys, (d) through the lungs.

362. State the chief function (a) of arteries, (b) of capillaries. Show how each of these organs is adapted by structure to perform the function stated. How are red corpuscles fitted to perform their principal function?

363. Show in what ways ill health may result from defective teeth.

364. State four precautions with regard to the care of the teeth and explain why it is necessary to observe each precaution in order to prevent the decay of the teeth.

365. State the uses of each of five of the nutrients.

366. Name five common foods and mention the nutrients that are abundant in each.

367. Discuss the effects of alcohol on muscular activity.

368. In what parts of the alimentary canal may proteid be digested? By what fluid is proteid digested in each of the parts mentioned?

369. Describe an experiment performed in the laboratory to show the digestion of proteid.

370. Name three of the most common causes of defective vision. How may each of the defects referred to be remedied?

371. Describe an effective method of ventilating a sleeping room in cold weather and state the reason for each step of this method.

372. What should the individual do to avoid contracting tuberculosis and to prevent its spread? What should the community do to protect its members from tuberculosis?

373. (a) Describe the action of the ribs and of the diaphragm in breathing and show why these movements make inhaling and exhaling possible. (b) State the use of oxygen in the body.

374. Locate and describe the three principal divisions of the nervous system and state the chief function of each.

375. Show by means of labeled drawings the internal and the external structure of the femur. Describe two adaptations to be found in this bone.

376. (a) Name and locate two glands found in the skin and state their respective functions. (b) Describe the layers of the skin and state the functions of each layer.

377. (a) Describe the methods of determining the presence of each of four of the nutrients. (b) How may it be proved that expired air contains carbon dioxide?

378. Describe an experiment with an animal membrane to illustrate osmosis. Mention two examples of osmosis in the human body essential to the continuation of life.

379. Discuss the necessity of a mixed diet. Make a list of food articles for a dinner that would insure a mixed diet, giving the nutritive value of each food mentioned.

380. Make a drawing of the alimentary canal, indicating each part. Give hygienic directions that should be observed in eating and give a reason for the observance of each.

381. Give the number and the position of each of the different kinds of teeth in a full adult set. State the main cause of the decay of teeth and the best method of preserving teeth that are partially decayed.

382. Name and locate the valves of the heart. Describe the action of one set of the valves of the heart.

383. State the necessity of respiration. Describe an experiment you have observed to illustrate the normal action of the chest and the diaphragm in breathing.

384. State the effect of the habitual use of alcoholic drink (a) on digestion, (b) on the nerves.

385. State the importance of getting rid of the wastes of the body. Mention three waste products of oxidation in the body and state how each is eliminated from the body.

386. Compare the structure and the method of control of the voluntary muscles with the structure and the method of control of the involuntary muscles. Mention two important voluntary muscles and two important involuntary muscles.

387. Describe the proper treatment (a) of a burn, (b) of a fracture.

388. State the dangers of dust. Describe proper methods of sweeping and dusting.

389. Give five practical suggestions for the care of the eyes.

390. Describe adaptation of structure to function in each of the following: spinal column, shoulder joint. Describe the gross structure and state the chief function (a) of the brain, (b) of the spinal cord.

391. Describe experiments you have observed to show the presence (a) of proteid, (b) of fat.

392. Mention (a) two characteristics of hydrogen, (b) two characteristics of nitrogen. Name a compound produced as a waste product in the body by the oxidation of fat and state by what organs most of this compound (waste product) is excreted.

393. Mention three advantages to be derived from cooking meat. Give two methods of cooking meat and discuss the merits of each method given.

394. Name a digestive fluid that acts on proteid; one that acts on starch; one that acts on fat. Mention the gland by which each fluid named is secreted. State why food must be digested.

395. Trace the course of the blood from the time it leaves the left ventricle till it returns to the same cavity.

396. Describe an experiment to illustrate oxidation, stating (a) apparatus and material used, (b) method of performing the experiment, (c) results observed, (d) conclusion.

397. State the effects of the excessive use of alcoholic drinks on the lining of the digestive tract ; on the process of digestion.

398. Describe proper emergency treatment in a case of apparent drowning ; in a case of hemorrhage resulting from a cut of a large blood vessel.

399. Describe bacteria as to size and method of reproduction. Name two diseases due to the presence of bacteria and state the best methods of preventing an attack of each disease named. Mention five chief duties of a board of health.

400. Give two important reasons for cleanliness of person. State the advantage and the disadvantage of (a) a hot bath, (b) a cold bath. Mention the best time of day for each.

401. Describe the gross structure of voluntary muscles. Mention four important voluntary muscles and state the function of each muscle mentioned.

402. Describe two structural adaptations of the spinal column and state the value of each adaptation described. State fully the difference in composition between the skeleton of a child and the skeleton of an adult.

403. Describe fully experiments to show the composition of bone.

404. Mention three characteristics of oxygen ; three of nitrogen. Name a compound formed as a waste product in the body of the oxidation of nitrogenous substance and state by means of what organs this compound is largely excreted.

405. What nutrient (food principle), other than water, is present in considerable quantity in each of the following: peas, cheese, bacon, oatmeal, chicken, eggs? Mention two chief uses of food to the body.

406. Describe fully the processes of digestion and absorption of starchy food.

407. State the effect (a) on the heart of the habitual excessive use of tobacco, (b) on the arteries of the habitual excessive use of alcoholic drinks.

408. Mention the blood vessels connected with the right chambers of the heart and state the function of each blood vessel mentioned. Describe the structure and the action of the tricuspid valve.

409. Describe the structure of the lungs and state their function. Describe the adaptations of the trachea and the air sacs for their respective functions.

410. Describe an experiment to show the growth of bacteria. Mention two ways in which the action of bacteria is beneficial.

411. Give directions for proper emergency treatment of (a) a fracture, (b) a deep cut, (c) a burn.

412. Describe (a) the structural adaptations of a long bone, e. g. the femur, (b) the gross structure and the action of the shoulder joint.

413. Locate and describe the three principal parts of the nervous system and state the function of each part described.

414. Explain the necessity of good food, fresh air, exercise and rest for normal action of the muscles.

415. Describe each layer of the skin. Mention three functions of the skin and state how the skin is well adapted to perform each function mentioned.

416. Describe an experiment to show the digestion of proteid food. State why proteid food must be digested and name the chief digestive fluid that acts on such food.

417. Describe the process of oxidation in the body and state its purpose. By means of what organs are the materials for this process introduced into the body.

418. Mention four kinds of common foodstuffs that are sometimes adulterated and state in each case the nature of the adulteration. What national law has been enacted to prevent the adulteration of food?

419. Describe an experiment to show the digestive action of gastric juice.

420. Mention two functions of the lymph and state how these functions are performed. State the effect of vigorous exercise on the blood.

421. Describe fully the action of the ribs and the diaphragm in breathing.

422. State (a) the effect on the heart of the excessive use of alcoholic drink, (b) the effect on the digestion of the habitual use of narcotics.

423. Mention the organs that communicate with the left chambers of the heart and state the function of each organ. Describe the action of the mitral valve.

424. State what part of the respiratory system is most susceptible to each of the following: tuberculosis, catarrh, pneumonia, diphtheria. State the nature, the location and the effects of adenoids.

425. Describe the minute structure of voluntary muscle tissue. Mention two organs of the body in which involuntary muscle-tissue is found and state the function of each of these organs.

426. Describe the proper method of dressing a wound made by a rusty nail and give reasons for using the method described.

427. Explain the adaptations of structure to function in each of the following: skull, elbow joint, long bone of the leg, molar teeth, lungs.

428. State the position of the kidneys in the body and describe their structure. Mention the change in the blood that occurs in the kidneys and state the importance of this change.

429. State the purpose of each of the following: vaccination, quarantine, antitoxin, antiseptics, ventilation.

430. State the law of osmosis. Mention two vital organs in which osmosis occurs and discuss its importance in each organ mentioned.

431. State how to show experimentally the necessity of the digestion of starch for use in the body. Describe a chemical test for starch.

432. Describe the structure and state the function of (a) arteries, (b) veins.

433. Describe the structure of a white blood corpuscle. Mention two important functions of white blood corpuscles.

434. State the effect on the organs of circulation of the habitual use of the following: (a) drinks containing a small amount of alcohol, (b) drinks containing a large amount of alcohol.

435. Describe the gross structure of the liver. Discuss the importance of each of two functions of the liver.

436. Describe (a) the process of digestion of proteid food, (b) the process of absorption of proteid food.

437. From what nutrient and by what process is urea formed in the body. By what organs is urea excreted?

438. Describe the gross structure of a voluntary muscle. Make a label drawing, showing the minute structure of voluntary muscle.

439. Describe the principal adaptations of structure to function in (a) the pelvic girdle, (b) the pectoral girdle.

440. Name five principal parts of the eye and state the function of each part named.

441. Discuss the importance to the household of (a) a pure water supply, (b) proper methods of sweeping and dusting.

442. Answer both *a* and *b*;

a Name five contagious diseases and mention a method by which each may be transmitted.

b Describe an efficient method of disinfecting a room in which a contagious disease has existed.

443. What nutrient, other than water, is present in considerable quantity in each of the following: beans, potatoes, lean meat, butter, apples? Of what general use to the body is each of two of the nutrients mentioned?

444. Discuss the relative merits of the following methods of preparing meat for the table: roasting, boiling, stewing, frying.

445. Describe the process of the digestion of butter.

446. State the location, shape, size and function of the adult hearts. Explain how the heart is well adapted by structure to perform its work.

447. Describe a method of resuscitating a person who is unconscious from apparent drowning and state the purpose of each step in the method described.

448. State the effects of alcoholic drinks on (a) the mucous membranes of the body, (b) the capillaries of the skin.

449. Give the position and the general structure of each part of the alimentary canal and state the function of each part.

450. Describe each layer of the skin. Explain the importance of bathing.

451. Explain how each of the following is adapted by structure to perform its function: long bone of the leg, molar tooth, nail, ribs.

452. Make a labeled diagram to show the course of the circulation of the blood, omitting the portal circulation.

453. Give five practical suggestions for the care of the eyes.

454. State (a) three ways in which tuberculosis is spread, (b) two means by which a community may protect its members from tuberculosis.

455. Mention two characteristics of oxygen and two of carbon. Name the substances formed in the body as waste products by the oxidation of carbohydrates and mention the organs by which these waste products are largely excreted.

456. State the necessity of a mixed diet. Name a combination of foods that would insure a mixed diet and give the most important nutriment in each food named.

457. Trace the course of the blood in the pulmonary circulation. State the changes that occur in the blood during this circulation.

458. Mention the danger of using patent medicines without the advice of a physician. State how the national government endeavors to lessen the harm done by the use of patent medicines. Give the effect of alcoholic drinks on digestion. Describe bacteria as to size and form. Mention two diseases due to bacteria or other

microörganisms and give an effective method of preventing an attack of each disease mentioned.

459. Explain how the lungs are adapted by structure to perform their function. State the advantages of breathing through the nose.

460. Mention the principal parts of the nervous system. Describe the external appearance of the spinal cord and state its chief function.

461. Define five of the following: capillary, quarantine, lymph, retina, pericardium, ventricle, nucleus.

462. Mention three structural adaptations of the spinal column and state the special use of each adaptation mentioned.

463. State the chief points of difference in structure and composition between the skeleton of a child and that of an adult.

464. Why is a poor sewerage system dangerous to a community? Mention three chief duties of a board of health.

465. Describe a chemical experiment to prove the presence of grape sugar in honey or other food.

466. Describe experiments to show the composition of bone.

467. From what nutrients and by what process is carbon dioxide formed in the body? By what organs of the body is carbon dioxide excreted?

468. State the chief function and describe the structural adaptations of (a) arteries, (b) capillaries.

469. Describe fully the process of digestion and of absorption of the white part of an egg.

470. Define narcotic, stimulant. Name two common narcotics and give an argument against the use of each.

471. Describe the process of the clotting of blood and state the use of clotting in a wound. What emergency treatment should be given in case an artery is cut? in case a vein is cut?

472. Mention two kinds of bacteria that are beneficial to man and state in what way each kind mentioned is beneficial.

473. Mention three reasons why air should be breathed through the nose rather than through the mouth. State the effect of tight lacing on respiration.

474. Give the number and the position of each kind of teeth in an adult. Describe the gross structure of a tooth.

475. Mention changes in the blood that occur when it passes through (a) the lungs, (b) the kidneys. State the composition and the function of the lymph.

476. Mention two principal uses of the skeleton. State how each of the following is adapted by structure for its work: elbow joint, hip joint, neck joint.

477. Give the proper emergency treatment of (a) a fracture, (b) asphyxiation by coal gas.

478. State the chief use of each of the five kinds of nutrients (food compounds) to the body. Name five common foods and mention a nutrient abundant in each food.

479. Describe fully the process of digestion of lean meat.

480. Describe the structural adaptations of the following for respiration: (a) the trachea, (b) the air sacs of the lungs.

481. State the chief differences in structure between the arteries and the veins. Mention the principal functions of each of the following: white corpuscles, red corpuscles, plasma.

482. Describe the external structure of (a) the cerebrum, (b) the cerebellum. State the chief function of each.

483. Mention two organs of excretion and describe the structural adaptations of each.

484. State the effect of the excessive use of alcoholic drinks on (a) the organs of circulation, (b) the alimentary canal.

485. Define five of the following: femur, oxidation, pleura, antiseptic, villi, disinfectant, diaphragm.

486. State (a) why food is usually heated before it is canned, (b) why cans are sealed. Mention two ways of preserving food, other than by canning, and state why each way is effective.

487. Give directions for emergency treatment when (a) large blood vessel is cut, (b) a poisonous substance is swallowed.

488. Discuss the importance to a city of (a) an abundant supply of pure water, (b) an efficient drainage system.

489. Describe (a) an experiment to show the presence of starch in food, (b) an experiment to show the presence of fat.

490. Make a labeled diagram to show the course of the blood in its circulation through the heart, lungs and capillaries. (Indicate by arrows the direction of the flow of blood.)

491. Describe the digestion of fatty food and mention the channels by which this food reaches the blood after digestion.

492. What nutrient (food principle), other than water is present in comparatively large per cent. in each of the following: eggs, lean meat, butter, white bread, apples?

493. State what part of the respiratory system is most often attacked by each of the following: tuberculosis, catarrh, pneumonia, diphtheria. State the nature, location and effect of adenoids.

494. Mention two benefits to be gained by cooking meat to be used as food. Give two methods of cooking meat and state the merits of each method given.

495. Mention four narcotics. Give the injurious effects that may result from the use of narcotics. State the benefits of the Pure Food and Drug Law.

496. State the importance of getting rid of the waste of the body. Mention three waste products of the body and tell how each is excreted from the body.

497. Describe experiments to show three characteristics of carbon. State the chief use of carbon in the body and mention the process by which it becomes useful to the body.

498. Describe an experiment to illustrate the digestion of proteid food. State the necessity of the digestion of proteid and mention the chief use of such food to the body.

499. Give (a) two structural adaptations of the femur, (b) the gross structure and the action of the hip joint.

500. Define five of the following: osmosis, antitoxin, lacteal, assimilation, cornea, epidermis, reflex action.

501. Describe an experiment you have observed to show the growth of a colony of bacteria. Give the characteristics of bacteria.

502. Give practical suggestions for the care of the eyes.

503. Mention three duties of a board of health and state the importance of each duty.

GLOSSARY.

Abdomen. The largest cavity of the body, the belly, containing the liver, the stomach, the intestines, etc.

Absorbents. The vessels which take part in the process of absorption.

Absorption. The process of taking up the fluids by and into the blood by means of an animal membrane.

Albumen, Albumin, or Albuminoid. An animal substance resembling the pure white of an egg.

Albuminose. A soluble animal substance resulting in the stomach from the digestion of albuminoid substances.

Alimentary Canal. A long tube in which the food is digested, or prepared for absorption into the system.

Anæsthetics. Those medicinal agents which prevent the feeling of pain. Chloroform, ether, etc.

Aorta. The largest artery and main trunk of all the arteries in the body. It arises from the left ventricle of the heart.

Aqueous Humor. A colorless, watery fluid occupying the space between the cornea and the crystalline lens of the eye.

Arachnoid Membrane. A very thin, middle covering of the brain lying between the dura mater and the pia mater.

Artery. The vessel by which the blood is conveyed away from the heart.

Articulation. The joining, or movable union, of bones, etc.

Arytenoid Cartilages. Two small cartilages of the larynx, resembling the mouth of a pitcher.

Asphyxia. A state of suspended animation, or apparent death.

Assimilation. The conversion of food into living tissue.

Atlas. The first vertebra sustaining the head.

Auditory Nerve. One of the cranial nerves; the special nerve of hearing.

Auricle. A cavity of the heart.

Axis. The second vertebra, on which the atlas rests and turns with the head.

Belladonna. A vegetable narcotic poison. It has the special property of enlarging the pupil, and thus increasing the brilliancy of the eye.

Bicuspsids. The fourth and fifth teeth on each side of the jaws, so named because they have two prominent points.

Bile. The gall secretion of the liver; a viscid, yellowish fluid, very bitter to the taste.

Bronchi. The first two branches of the trachea, each of them entering a lung.

Bronchial Tubes. The smaller branches of the trachea within the substance of the lungs, ending in the air-cells.

Bronchitis. An inflammation of the lining membrane of the bronchial tubes; a "cold" affecting the lungs.

Canal. Any tube or passage in the body or its organs.

Cancer. A malignant disease, usually in the form of an ulcer or a tumor.

Canine. The third tooth on each side of the jaw. The eye-tooth in the upper jaw.

Capillary. An extremely fine blood-vessel which connects an artery with a vein.

Carbon. One of the four great chemical elements, found everywhere in nature.

Carbon Dioxid, Carbonic Acid Gas, CO₂. The gas present in the air expelled from the lungs; a waste product of the animal kingdom, but a food of the vegetable kingdom.

Cardiac. Pertaining to the heart.

Carotid Artery. The large artery of the neck, supplying the head and brain.

Cartilage. A white, elastic substance forming a part of the joints, nostrils, etc.

Casein. The albuminoid substance of milk.

Cerebellum. The little brain, situated beneath the posterior third of the cerebrum.

Cerebrum. The brain proper, occupying the entire upper portion of the skull.

Choroid. The middle coat of the eyeball, containing the pigment cells.

Chyle. The milky fluid formed by the digestion of the fatty food in the intestines.

Chyme. The pulpy mass formed by digestion within the stomach.

Cilia. Minute, hair-like processes found upon the cells of the air-passages and other parts that are generally moist.

Circulation. The course of the blood through the blood-vessels of the body, from the heart to the arteries, through the capillaries to the veins, and from the veins back to the heart.

Cirrhosis. A disease of the liver which causes this organ to become hard and yellowish.

Chloral. A sleep-producing drug.

Coagulation. The thickening of the blood into a solid mass.

Cochlea. The spiral cavity in the internal ear.

Colon. Part of the intestines. See illustration.

Concha. The shell-shaped portion of the external ear.

Conjunctiva. A thin layer of mucous membrane which lines the eyelids and covers the front of the eyeballs; inflammation of this membrane is called conjunctivitis, trachoma, or "pink eyes."

Contractility. The property of muscle which enables it to draw its extremities closer together, or the power of shortening and lengthening.

Convolutions. The foldings of the external surface of the brain.

Convulsion. A violent agitation of the limbs or the body.

Coma. A state of unnatural sleep or stupor.

Congestion. A great fulness of the vessels, canals, or ducts.

Cornea. The transparent substance which covers the anterior part of the eyeball.

Corpuscles (Red Blood). The small bi-concave bodies or discs in the blood which give to it the red color; the white corpuscles are globular and larger, and are found with the red corpuscles.

Cranial. Pertaining to the skull. The cranial nerves are those arising from the brain.

Cranium. The cavity which holds the brain.

Cricoid. The cartilage of the larynx, resembling a seal-ring.

Crystalline Lens. One of the transparent, double-convex humors of the eye.

Cuticle. The outer skin, the epidermis, the scarf-skin.

Cutis. The true skin, or dermis, lying beneath the cuticle.

Daltonism. Color blindness.

Decussation. The crossing of fibres from side to side. See answer 256.

Diaphragm. A large, thin muscle separating the cavity of the chest from the abdomen; a muscle of respiration.

Diastole. The expansion of the heart, which allows blood to rush into it. Opposite of Systole.

Diffusion of Gases. The power of gases to become intimately mingled, without reference to the force of gravity.

Duct. A narrow tube.

Delirium Tremens. The disease resulting from the excessive use of alcoholic beverages.

Deltoid. The large, thick muscles covering the shoulder-joint.

Dementia. Great feebleness of the mind.

Dentine. The bone which forms the bulk of the tooth.

Dipsomania. A disease which manifests itself by a craving for alcoholic drinks.

Distillation. The process of separating pure alcohol from other substances.

Duodenum. The first division of the small intestines.

Dura Mater. The outermost tough membrane which covers the brain.

Dyspepsia. Difficult or painful digestion, due to the disordered condition of the stomach.

Enamel. The smooth, dense material which covers the crowns of the tooth.

Endocardium. The lining membrane of the heart.

Energy, Specific. "When a nerve of special sense is excited, whatever may be the cause, the sensation experienced is that peculiar to the nerve; this is said to be the law of specific energy of the nerves."

Epiglottis. The piece of cartilage which covers the top of the larynx.

Esophagus. The tube leading from the throat to the stomach. The gullet.

Eustachian Tube. A tube running from the drum of the ear to the throat.

Excretion. The separation from the blood of the materials that cannot be used by the body.

Exhalation. The vapor sent forth from the body.

Expiration. The act of forcing or driving out the air from the lungs.

Extension. The act of extending or restoring a limb to its natural position after it has been flexed. Opposed to Flexion.

Fenestra Ovalis. The opening between the middle and the internal ears.

Fermentation. The peculiar change which takes place when moist animal or vegetable matter is exposed to the air at ordinary temperatures.

Fibrine. The albuminoid substance, made of delicate threads or filaments, found in the blood, which aids in coagulation.

Flexion. The act of bending a limb. Opposed to Extension.

Follicle. A little pouch or depression in a membrane, possessing a secretory function.

Filament. A small thread-like substance.

Ganglion. A swelling in the course of a nerve making it a smaller nerve center.

Gastric Juice. The principal digestive juice, secreted by the stomach.

Gland. An organ consisting of follicles and ducts, with numerous blood-vessels, whose function it is to separate some particular fluid from the blood for use in one or more of the necessary life processes.

Glottis. The opening at the top of the larynx.

Glossopharyngeal Nerve. The nerve of taste supplying the posterior third of the tongue and the throat.

Gluten. The albuminoid substance of wheat.

Gustation. The sense of taste.

Gustatory Nerve. The nerve of taste supplying the front part of the tongue, forming a branch of the "fifth" pair.

Hemorrhage. Bleeding, or loss of blood, from a cut or rupture.

Hemiplegia. Paralysis, or loss of power, affecting one side of the body.

Hemispheres. The halves of the cerebrum, or brain proper.

Hepatic. Pertaining to the liver.

Humor. Transparent substances or media of the eyeball.

Hysteria. A nervous disease frequently occurring among women.

Hydrophobia. A usually fatal disease caused by the bite of a rabid or mad dog, or other animal. The person so affected generally goes into convulsions at the sight of a glittering object or the sound of running water, and by almost any strong external impression.

Incisors. The front teeth of both jaws, which have sharp cutting edges.

Incus. The name of one of the three bones of the middle ear.

Insalivation. The intermingling of the saliva with the food during mastication.

Inspiration. The act of drawing the air into the lungs.

Integument. The skin, or outer covering of the body.

Intestines. The part of the alimentary canal which is continuous with the lower end of the stomach; also called the bowels.

Iris. The thin, muscular ring which lies between the cornea and the crystalline lens, giving to the eye its distinctive color.

Jugular. The large veins which run along the front of the neck.

Labyrinth. The cavity of the inner ear, comprising the vestibule, the semi-circular canals, and the cochlea.

Lachrymal. Pertaining to the tears.

Lacteals. The absorbent vessels of the small intestines. During digestion they are filled with the milky chyle.

Larynx. The cartilaginous tube situated at the top of the windpipe, or trachea, and forming the organ of voice.

Lens. A piece of transparent media or substance so shaped as to converge or disperse the rays of light.

Ligament. A strong, elastic material binding bones or other solid parts together, thereby giving strength to the joints.

Lymph. The colorless, watery fluid conveyed by the lymphatics, a system of absorbent vessels.

Malleus. One of the three small bones of the middle ear.

Marrow. The soft, fatty substance contained in the central cavities of the bones. The spinal marrow is composed of the nerve tissue.

Mastication. The act of cutting and grinding the food by means of the teeth, commonly called chewing, for the purpose of allowing the saliva to act on the food in the first step of digestion.

Medulla Oblongata. The nerve cord, continuous with the spinal cord and the brains.

Membrane Tympani. The delicate partition separating the outer from the middle ear. The drum of the ear.

Membrane. A thin layer of tissue serving to cover some part of the body.

Molar. The three back, grinding teeth on each side of the jaw.

Motor. The name of those nerves which conduct to the muscles the stimuli which cause them to contract.

Mucous Membrane. The thin tissue covering the cavities or passages which communicate with the external air.

Mucus. The fluid which is secreted by the mucous membranes and which serves to keep them continually moist.

Melancholia. A disease characterized by sadness or depression.

Myopia. Near-sightedness.

Nasal. Pertaining to the nose. The nasal cavities contain the special nerves of smell.

Nerve. A glistening white cord of cylindrical shape, connecting the brain or spinal cord with some other organ of the body.

Nerve Cell. A minute, round, gray cell found in the brain and other nervous centers.

Nerve Fibre. An exceedingly slender white thread of nervous tissue found in the various organs of the nervous systems, especially in the nerves.

Narcotic. A substance which diminishes the activity of the nervous system.

Neuralgia. A pain in the nerve or nerves, usually of the face.

Nicotine. The active principle of tobacco.

Nutrition. The processes by which the wastes of the body are replaced by substances essential for growth and repair.

Oesophagus. The tube leading from the throat to the stomach. The gullet.

Oleaginous. Oily; fatty; pertaining to the fats.

Olfactory. Pertaining to the sense of smell.

Optic. Pertaining to the sense of sight.

Orbit. The bony cavity in which the eyeball is placed.

Osmosis. The process by which liquids are impelled or forced through moist membranes.

Osseous. Consisting of, or pertaining to, bones.

Palate. The roof of the mouth, consisting of the hard and the soft palates.

Pancreas. A long, flat gland, situated near the stomach. The sweetbread in animals.

Papillæ. The tiny prominences in which terminate the fibers of the nerves of taste and touch.

Paralysis. A nervous disease marked by the loss of the power to respond to stimuli.

Parotid Gland. A salivary gland situated near the ear.

Paraplegia. A form of paralysis affecting the lower half of the body.

Patella. The small bone forming the knee-cap, or knee-pan.

Pectoral. Belonging to, or pertaining to, the chest or breast.

Pelvis. The bony cavity forming the lower part of the trunk.

Pepsin. The active organic principle of the gastric juice.

Pericardium. The porous membrane enclosing the heart, and secreting the lubricating fluid that protects the heart.

Peristalsis, Peristaltic Movement. The wave-like, projecting movement of the intestines and the stomach.

Peritoneum. The covering membrane of the stomach, intestines, and other abdominal organs.

Perspiration. The sweat.

Pharynx. The cavity between the back of the mouth and the esophagus.

Pia Mater. The innermost and most tender of the three coverings of the brain.

Phthisis, Consumption, Tuberculosis. A destructive disease of the lungs, due to infection by the tubercle bacillus.

Plasma. The colorless liquid part of the blood.

Pleuræ. The membranes covering the lungs and the lining of the chest.

Pleurisy. An inflammation affecting the pleura.

Pneumogastric. The name of the nerve distributed to the lungs and to the stomach. It is the principal nerve of respiration.

Pneumonia. An inflammation of the air-cells of the lungs.

Pons Varolii. A mass of nerve fibres at the base of the brains, joining together the cerebrum, the cerebellum, and the medulla.

Presbyopia. The far-sightedness of adults and aged persons, due to the hardening of the crystalline lens.

Process. A method of doing or functioning. A projection from a surface.

Ptyalin. The peculiar organic ingredient in the saliva.

Pulmonary. Pertaining to the lungs.

Pulp. A soft substance in the teeth.

Pulse. The striking of an artery against the finger as the blood courses through it, occasioned by the contraction of the heart, and felt principally at the wrist.

Pupil. The central, round opening or hole in the iris, through which the light must pass to reach the retina.

Pylorus; Pyloric Orifice. The lower opening of the stomach, at the beginning of the small intestine, the cardiac orifice being at the other end, near the heart.

Reflex Action. An involuntary action of the nervous system by which an external sensation is converted into a motor impulse without the interposition or knowledge of the brain.

Respiration. The function of breathing, consisting of the inspiration, or breathing in, and the expiration, or breathing out.

Retina. The innermost of the three coats of the eyeball, being an expansion of the optic nerve.

Saliva. The fluid of the mouth, secreted by the three salivary glands, and necessary for the first step of digestion.

Sclerotic. The tough, fibrous outer coat of the eyeball.

Sebaceous. The oily secretion which keeps the skin and the hair oily, flexible and soft.

Secretion. The process of separating from the blood some fluid essential to one or more of the life processes. The substance so taken out is also called a secretion.

Semicircular Canals. In the internal ear.

Sensation. The perception of an external impression by the nervous system.

Sensibility, General. The power possessed by almost all parts of the human body of recognizing the presence of a foreign object in contact with them.

Serum. The watery constituent of the blood, which separates from a clot during coagulation.

Skeleton. The bony framework of an animal, showing the various parts in their proper relative position.

Stapes. One of the small bones of the tympanum, or middle ear.

Stimulant. A substance that has the power to excite or increase the force of the nervous system.

Sympathetic Nerve System. The double chain of nerve ganglia connected and joined by numerous small nerves, situated on both sides and in front of the spinal column.

Synovia. The white lubricating fluid of the joints.

Systole. The contraction of the heart, by which the blood is ejected from that organ. Opposite of Diastole.

Tactile. Relating to the sense of touch.

Temporal. Pertaining to the temples.

Tendon. The white, fibrous cord or band by which a muscle is attached to a bone.

Tetanus. A disease marked by the persistent contraction of some voluntary muscles. When those of the jaw are affected, it is called lockjaw; usually fatal.

Thorax. The upper cavity of the body (lower, the abdomen), containing the lungs, heart, etc. The chest.

Thoracic Duct. The duct which receives nutritious matter from the lacteals and pours it into the blood.

Thyroid. The largest of the cartilages of the larynx. The projection in the front of the neck is called "Adam's apple."

Tincture. A solution of any drug or medicinal substance in alcohol.

Trachea. The windpipe, composed in part of rings of cartilage.

Transfusion. The operation of injecting blood or other fluids or solutions taken from one person into the veins of another.

Tympanum. The cavity of the middle ear, enclosed by two membranes.

Urea. A waste substance, due to the oxidation of nitrogenous substances, secreted from the blood by the kidneys.

Uvula. The small hanging body attached to the back part of the palate.

Vascular. Pertaining to, or containing, blood-vessels.

Vasomotor Nerves. Nerves which go to blood-vessels.

Venous. Pertaining to, or contained in, a vein.

Ventilation. The introduction of fresh air into a room or building in such a way as to keep the air within in pure condition.

Ventricles. The two largest cavities in the heart.

Vertebral Column. The backbone, consisting of twenty-six vertebrae firmly joined together. Also called the **spine**, the **spinal column**.

Vestibule. A portion of the internal ear, communicating with the semicircular canals and the cochlea.

Villi. Minute projections found on the internal surface of the intestines.

Vitreous Humor. The humor occupying the largest portion of the eyeball.

Vivisection. The practice of operating upon living animals for the purpose of studying the functioning of some organ, or the effect of the introduction of some substance into the body of the animal.

Vocal Cords. Two elastic bands situated in the larynx, the vibrations of which produce voice.

Viscera. The large organs contained in the cavities of the body. See illustrations.

The Progressive Series

Answers in Anatomy,
Physiology and
Hygiene

for

DRILL, TEST AND REVIEW

By

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PREFACE.

A practical Question and Answer Book should be comprehensive in scope without having too many and too detailed questions. It should furnish abundant material for drill, test, and review of the subject by means of well arranged and well graded questions, and should aim to cultivate in the student those qualities brought out in a good recitation by a skilled teacher.

With these objects in mind this series of books has been written. The separate books are intended, not only for beginners, but also for students pursuing advanced and review work. Care has been taken to make each book complete. The papers given at civil service, college entrance, and Regents examinations have been carefully culled for suitable questions, and the material arranged topically and logically to emphasize principles as well as essential facts. The answers are supported by the latest authorities and in consonance with the accepted texts for the best elementary and secondary schools. To make the work more helpful, diagrams, illustrations, maps, topical outlines, and glossaries have been included.

Acknowledgment is due to the many experienced teachers who have freely offered suggestions and criticisms designed to make this a most helpful "text-book."

The aim of the book is to present in brief, concise form the leading facts and principles in ANATOMY, PHYSIOLOGY, and HYGIENE through the medium of questions selected from a very large number of papers and answers based on reliable and authoritative sources. Technical terms have been very largely avoided, and a glossary following the questions supplies the large number of terms used in the leading texts. The main facts and principles and working rules of individual and public hygiene are presented in such a way that the teacher and student may enlarge on them.

To my son
LEONARD -
whose questions
come from the mind
and the heart
this series is affectionately
DEDICATED

Answers in Anatomy, Physiology and Hygiene

THE BODY.

1. (a) The science of *anatomy* describes the parts and structure of the body. It teaches the locations of the many organs of the body. (b) *Physiology* tells us of the functions or uses of the various parts of the body and their organs. It describes the foods and their utilization in the building up of the muscles, bones, and brains; how the heart, the nerves and the blood, as well as all other parts of the human machine, perform their duties. It shows the need of good, wholesome foods, and the urgency for rest and exercise. (c) *Hygiene* discusses the preservation and improvement of the individual's health, and takes up the prevention of disease.

2. (a) A knowledge of the actions and functions of the various organs enables us to know the causes of ailments and the kind of remedy to be applied to effect a cure. It is an aid to hygiene (b) which, by showing us how to live rightly and well, helps us to avoid illness. A knowledge of both physiology and hygiene will aid in the saving of lives and the economic loss due to sickness.

3. Health is the basis of success, and is essential to the formation of the rightful habits that are a part of the education of youth. The instruction which helps the boy and the girl to understand the workings and care of his body, the value of good, wholesome food, of fresh air, plenty of exercise and sufficient rest, will add much to the physical development and upbuilding of the body and bring about a decrease in sickness. Sickness will not be so terrible and costly; the industries will not be interrupted and such enormous losses caused. It has been estimated that between four and eight millions of cases of serious illness can be averted by hygienic living, and hundreds of millions of dollars annually saved to the wealth of the nation.

4. A *cell* is the smallest unit of matter capable of independent existence. It is a microscopic mass of *protoplasm*, containing a *nucleus*, and enclosed in a *cell wall*. The tissues of the body are composed of innumerable cells.

5. There are as many kinds of cells as there are different kinds of tissues, each of these cells and tissues having a different duty to perform. Muscle cells, fat cells, nerve cells, epithelium cells, bone cells, blood cells, etc., are some of those found. See answer 6.

6. (a) A *tissue* is a combination or union of like cells, having a certain, definite work to perform. (b) The various tissues in the body may be classified as *connective* tissues and *active* tissues, the latter, muscles, nerves, etc., being those by which the activities of the body are performed. The chief function of the connective tissues is that of support; they connect and hold in place the various organs of the body, besides forming a fine delicate covering over these organs. Professor Ford classifies the tissues as follows:

1. *Osseous*—Bones and teeth.
2. *Cartilaginous*—Pure cartilage and fibro-cartilage.
3. *Fibrous*—White and yellow, *i.e.*, the firm and strong, to bind parts together, and the elastic to afford elasticity and freedom of movement.
4. *Muscular*—Striated or voluntary muscles, and non-striated or involuntary.
5. *Adipose*—Fat cells and enclosed fat.
6. *Epithelial*—Epithelium, epidermis, hair, and nails.
7. *Nervous*—Cerebro-spinal and sympathetic.

7. (a) An *organ* is a group of tissues which combined have a special use or function; e.g., the heart, the liver, the lungs. (b) A *system* is composed of many organs, each having the like functions, and each contributing to the general process of the entire system. (c) The *muscular* system, the *nervous* system, the *respiratory* system, the *digestive* system, the *circulatory* system, the *excretory* system, the *osseous* system or bones. These systems must work together in harmonious relations, as a derangement in any one system has an unsalutary effect on the others, and may cause illness.

8. Fresh air, plenty of good, wholesome food, sufficient exercise, recreation, and rest, temperate habits, these are all essential to "a sound mind in a sound body."

FOODS.

9. (a) Water, two-thirds; (b) solid matter, one-third.

10. The solid matter consists of (a) *mineral* matter, such as lime, soda, salt, iron; (b) *proteids* or albumen, like the white of an egg; (c) *fats*, such as tallow, lard, oils, and (d) *carbohydrates*, or sugar and starch. The mineral matters are important in the building up of the bones, the proteids in the tissue building, the fats and the carbohydrates for their heat-giving qualities.

11. By the burning of a bone. The residuum is the ashes, composed entirely of mineral matter.

12. The five chief food stuffs, or proximate principles, are *mineral salts, water, proteids, fats, and carbohydrates*.

13. (a) *Proteids, or albumens*, are a substance making up about four-fifths of the solid part of muscles, and are present in all tissues. They form the essential part of the protoplasm, and are made up of the four essential gases, carbon, hydrogen, oxygen, and nitrogen, in various compounds. (b) The principal albuminoid constituents are: albumen found in flesh, blood, milk, seeds, and grains, and in its purest form in the albumen, or white of the egg; fibrin, found in the blood, lymph, and chyle, in some of the semi-solid animal tissues, in the gelatine extracted from bones, and in some of the vegetable juices, gluten, in the cereals, in varying quantities; casein, in milk, and in coagulated form in cheese, in peas, beans, etc.

14. Fats are found in all parts of the body and constitute varying proportions of the different organs; the brain is one-tenth fat; the nerves, one-fifth; and the adipose tissues, four-fifths. Beneath the skin is a layer of fat varying from one-tenth to one-fifth of an inch in thickness. The fat in this layer is being constantly converted into carbon dioxid and water by the bodily processes. This conversion causes the bodily heat. Moreover, as in the case of the bear, the fat can be used as a food by the body when the person is unable to secure food externally. This utilization of the internal

fat causes the change from fatness to slimness. Fats are kept in a liquid state in the living body by the bodily heat.

15. (a) An *oil* is a fatty substance in liquid state. (b) An *emulsion* is a mixture of oil and water united by a mucilaginous element. Without some emulsifying substance, such as ammonia, fat and water do not form a lasting mixture; but the addition of ammonia to the other ingredients causes the division of the fatty substance into minute, white globules, thus transforming the oil and water into an emulsion, which is permanent. (c) To make an emulsion, add to fat and water a few drops of ammonia, shaking the mixture well.

16. *Carbohydrates*, or starches and sugars, due to the conversion by means of living cells, are changed into carbon dioxide, gas and water, and thereby give off heat. They help to keep the body warm. Sugar occurs in the juices of many plants, and may be formed from the starch in ripe fruits.

17. See answers 14 and 16.

18. Owing to the differences in the occupations between the teacher and the laborer, the foods are necessarily to be different, not in substance, but rather in amount of each consumed. The laborer who performs manual or physical labor consumes a greater amount of fats and carbohydrates, while the teacher, who exercises his brain power, his nerve power, to a greater extent, and whose occupation is more or less sedentary and indoors, requires more of the proteids.

19. The elements most abundant in living bodies are *carbon*, *oxygen*, *hydrogen*, and *nitrogen* (Cohn). Carbon is plentiful in all foods that are eaten, and makes up more than half of lean meat. It is the chief solid element in muscles, fats, starches, and sugar. Hydrogen is present in nearly all foods, and forms two-thirds of the volume of water. Oxygen is another gas forming one-third of the volume of water, and makes up about one-fifth of the solid portion of all living things. It is the most important of all essential elements, being absolutely necessary for life. The carbon and the oxygen in the body form the carbon dioxide that is exhaled. Without oxidation, or the combining of the oxygen gas with any other substance, the life processes cannot go on and the being dies. The nitrogen is an elementary

essential in the tissues, being in many of them the most important of the ingredients. It is the chief element in the food of plants and animals. This gas forms four-fifths of the air.

20. The oxygen of the inhaled air, passing through the nose and the windpipe is carried on by the blood throughout the body where, by admixture with the various substances, it causes, through the oxidation process, bodily heat and energy. This makes the muscles move and the organs do their allotted work. The greater the work done in amount or quality, the greater the energy consumed. Consequently, when we are hard at work we consume a greater amount of energy, and therefore require a greater supply of oxygen; and as we need this, we must breathe faster, in order to inhale the oxygen.

21. See answer 19. The nitrogen is the chief essential in the structure of tissues.

22. (a) Food is any substance taken by the body and consumed by it for the purpose of repairing and rebuilding the parts of the body, and for supplying heat and energy. (b) The waste processes of a living body are always going on; at some part or other the tissues are dying. It is necessary to replace these dying parts. Proteids do this work; they nourish the dying parts. Moreover, the body is always at work, in some form or another. Consequently, heat and energy are being given off and consumed. The carbohydrates and fats supply sufficient heat and energy to replace the expended heat and energy.

23. (a) Water is the carrier of the food throughout the body, and forms an integral part of the various tissues and organs of the body. Food cannot be digested unless it is in liquid form, and water forms a large part of the digestive juices. (b) The mineral salts are absolutely essential for the proper nourishment of the body. Salts of various minerals, lime, potash, soda, iron, are needed for the building up of the various tissues, iron for the red blood corpuscles, lime for the bones, etc.

24. The quantity of food required varies greatly, according to the individual and his mode of life. Those living in the open and leading active lives require more food than the old and the persons leading sedentary lives. The inhabitants of the cold regions require more food than the dwellers in the warmer regions. Some are habituated to eat three hearty meals a day,

while others thrive on three light meals; some favor a large amount of liquid food, while others consume a greater amount of solid food.

25. The average daily diet for an adult, in good health, weighing about 154 pounds, and measuring about 5 feet 8 inches in height, simply to maintain his weight, is the following:

Food Substances.	Per Centum.	Weight.		
		lbs.	oz.	grs.
Water	81.5	5	8	320
Albuminoids	3.9		4	110
Starch, sugar, etc.....	10.6		11	178
Fat	3.0		3	337
Common salt	.7			325
Phosphates, potash, salts, etc.	.3			170
	—	—	—	—
	100.	6	13	128

It will be seen that this amount is about one-twenty-fourth of his entire weight, so that in twenty-four days the adult renews his body weight once.

26. The proportion of proximate principles from the various kingdoms that furnish the adult with food, the adult being in good health and leading a fairly active life, is as follows: the mineral kingdom furnishes three and one-half pounds, including water and salt; the vegetable kingdom, one and three-quarters pounds, particularly, bread, vegetables, and fruits; the animal kingdom, one and a half pounds, consisting of eggs, butter, meat, milk, etc.

27. A mixed diet is necessary for the individual because there is no one food (excepting milk for the infant) that comprises all the necessary principles of food, and that the continuous use of any one diet, in whatever condition it may be, leads to defective nutrition and the resulting diseases. Likewise, the absence of any necessary principle of food is followed by illness; as, the scurvy that is so much dreaded by sailors. The important thing to consider in the diet of any individual or people, is whether the chemical principles enter into the composition of the food, and whether these are in sufficient quantity to accord with the habits of the individual or the people.

28. A summary concerning diet. "The food on which the man who would be healthy should be selected so as to insure a variety without excess. Animal food should not be taken oftener than twice daily. The amount of animal and vegetable food combined should not exceed 30 ounces in the 24 hours; and for the majority of persons an average of 24 ounces of mixed solid food, a third only of which should be animal, is sufficient. All animal foods should be eaten while they are fresh, and after they have been well cooked. The habit of eating underdone flesh is an almost certain cause of parasitic disease. The amount of fluid taken, in any form, should not exceed the average of 24 ounces daily. Water is the only natural beverage."

29. Milk is the earliest nutriment of the human race, and may be regarded as a model food, because it can sustain life longer than any other article of the diet. Cow's milk contains the proteid casein, a fatty principle; sugar of milk, water and salts, all of which are easily digestible.

30. Eggs contain the proteid in the form of pure albumen, plenty of fat, about two-thirds water; but they lack in the sugar principle, and should, therefore, be eaten with bread or vegetables that contain the starch or sugar. Soft-boiled eggs are preferable to hard-boiled or fried eggs.

31. Meats are the muscular parts of various animals,—the cow, the goat, the sheep, the horse, the reindeer, and others—containing large quantities of albuminoid substances, with a varying amount of fat, they are the most important article of diet for adults. The beef eaters are, and always have been, the most progressive people in the world. The flesh of the young is more tender and more digestible than the flesh of the older animals. When exposed or not preserved, meats tend to become putrid, that is, the fats and the albuminoids tend to decompose; it is necessary to preserve them by smoking, by freezing, by salting in brine, etc.

32. Cooking is essential in the preparation of food for proper digestion because it softens the food, develops the flavor, and raises the temperature of the food. The objects to be obtained by cooking meat are: 1. To coagulate the albumen and blood of the tissues, so as to render the meat agreeable to the sight.

2. To develop flavors, and to make the tissue crisp, as well as tender, and therefore more easy of mastication and digestion. 3. To secure a certain temperature, and thus to be a means of conveying warmth to the system. 4. To kill parasites in the tissue of the meat.

The action of heat should not be continued after these objects are accomplished, as the meat will thereby be rendered indigestible.

33. Fish, while it closely resembles the meats in composition, is more watery and is ill fitted to strengthen the mind and the body. If made the chief article of diet, it produces a great variety of skin diseases. The salmon, trout, cod, and halibut are among the easily digestible fish, while the shell-fish in general lead to digestive troubles.

34. The list of vegetable foods is very large and varied. Many of them are most nourishing, without them man being unable to continue his existence, while others are positively destructive, as they contain virulent poisons. Many of them require little or no preparation to make them edible, while others must undergo many preparatory steps before they can be served as food. Some are depressing in their effect, while others are stimulating; some are important builders of tissue, while others are positively harmful.

35. Cereals, or grains, are many in number, and are used for the making of bread, which forms "the staff of life." Good or bad, bread in some form must be had. Bread made from wheat flour is the most nourishing, because it contains a greater proportion of starch and less gluten than the breads made from the darker flours, like the rye, corn, etc. In order to make the bread more digestible, it is rendered leavened or porous by a mixture of yeast or some other method of spreading the carbonic acid gas. Wheaten bread contains all the proximate principles with the exception of fat, which absence is remedied by the addition of butter, making bread and butter an almost perfect food.

36. Vegetables contain so many important mineral and other compounds that they form a most important element in food products. There is no people, no country, where vegetables, in one variety or another, do not form a most important article

of diet. Its importance is so far recognized as a food, and as a digesting aid, that no large meal is had without vegetables. The potato, probably the most common of the vegetables, forms the chief article of food in Ireland, in Germany, and among the poorer classes in the other European countries. It contains more than two-thirds water, the remainder being composed of starch and a little albumen.

37. Fruits are composed chiefly of water, in many of them the percentage going up as high as eighty-two. The fruits contain large amounts of starch, which during the process of ripening, is changed into sugar. Besides the fruits contain acids in smaller or greater quantities that aid in digestion. They form a most welcome change from the usual food dietary. The vegetables and fruits contain the valuable acids, malic, citric, tartaric, etc., which, combining with lime, soda, and potassa, form the malate salts, so essential to the furnishing of the alkalis to the blood and other fluids.

38. Water, milk, coffee, tea, chocolate, cocoa, alcoholic beverages.

39. Water is recognized as the most important liquid. Without it we could not live. It forms a comprehensible portion of our body weight and is a necessity. No person can exist without drinking water. It is important that the water that is drunk should be pure. It should be clear and colorless, with little taste or smell, and free from foreign ingredients. We seldom drink chemically pure water; it usually occurs with some mineral elements dissolved in it, giving it usually a saline taste. Impure water spreads disease, and so important is this that large cities go to enormous expense to keep their water supply free from impurities.

40. Coffee is recognized as a gentle stimulant, and not as a food that helps to build up the body. Moderate use is urged; too much is harmful, because it diminishes the waste of tissues, and consequently permits the performance of excessive labor on an economical and inadequate diet. Its excessive use leads to nervousness and impaired digestion.

41. Tea contains a principle called theine, similar to the caffeine in coffee. It is a mild and gentle stimulant, and should be used in moderation. Like coffee, its excessive use causes ner-

vous prostration. The black tea is not so strong as the green tea. Tea and coffee, taken in too large quantities, become nerve depressants.

42. Chocolate and cocoa contain fatty matter (also albuminous and starchy materials) and therefore are more valuable as foods. They also contain a substance similar to the theine and caffeine, theobromine, which is not so stimulating as the stimulating principles in tea and coffee.

43. (a) Alcohol is a clear, colorless, volatile, and inflammable liquid of penetrating odor and burning taste. It is lighter than water, and is frozen only at a very low temperature. (b) It is a temporary stimulant to the body, provided it is taken in small quantities, and not regularly. In larger amounts, in spite of all claims to the contrary, it is positively harmful and dangerous for its deleterious effects on the various systems in the body, particularly on the nervous system. It deadens sensibility, induces irregular muscular and heart action, in other words, it intoxicates. Without it there would be less illness and disease, and a greater amount of sustained regular work. The country would be economically richer without the sale and use of alcoholic drinks. It does not supply a steady amount of heat, it does not relieve the thirst. Its only proper use is as a stimulating agent under the prescription of a physician; that is, solely as a medicine.

44. Alcoholic drinks are classified as follows: (a) malt liquors, ales, beer, porter, and stout; (b) wines, (c) spirits, or whiskey, rum, gin, and brandy; (d) cordials, (e) milder alcoholic drinks, as cider, root beer, etc. These beverages have different percentages of alcohol in them, varying from less than ten per cent. in the cider and root beers to 54 per cent. in the brandies.

45. Tobacco is another substance that is sometimes claimed to be a food, but its use along that direction is more questionable than alcohol. Its temperate use may not apparently affect adults unpleasantly; it may act as a very mild sedative. But under no circumstances should the young be permitted to indulge in it. It is liable to produce an irritable condition of the heart and brain, to destroy the appetite and seriously affect the digestion

processes. It is known to produce "headache, confusion of intellect, loss of memory, impaired power of attention, lassitude, indisposition to muscular effort, nausea, want of appetite, dyspepsia, palpitation, tremulousness, disturbed sleep, impaired vision, etc."

46. Ptomaine poisoning results from the bacteria that were not killed in the cooking of the foods, meats or vegetables, before or after being put into the cans. These bacteria generate a ptomaine poison, which is not affected by later cooking. Fruits and vegetables, meats, etc., that are canned should be put into jars or cans and then cooked with the covers screwed on lightly for ten minutes until all the spores have been killed. Food should never be left in a metal can which has been opened.

THE DIGESTIVE SYSTEM.

47. The process of so dissolving and chemically changing the foods taken in by the body that they can be assimilated by the blood and the nutriment furnished to the body. The separation of the nutriment from the waste in the foods taken into the body. The preparation of the foods taken in by the body into chyme.

48. (a) The *alimentary canal*, the divisions of which are the *mouth*, the *pharynx*, the *oesophagus*, the *stomach*, and the *intestines*. (b) The assisting glands are the *salivary glands*, the *liver* and the *pancreas*. Figs. 3, 7.

49. The tongue and the teeth.

50. (a) The mouth is a large opening at the head of the alimentary canal and contains the organs of mastication and swallowing. (b) The roof of the mouth, consisting of the hard and the soft palates. Fig. 4.

51. (a) The tongue is composed of several muscles covered with mucous membrane and is essential in speaking and for the moving of the food in mastication or chewing. (b) When the person is in good health the tongue is clear, when in ill health, the tongue is coated with a white filmy stuff, a "furred tongue."

52. The *crown* is the part above the gum; the *root* is the part below it; the constricted portion between the crown and the fang is the *neck*; the *enamel* is the hard part covering the crown;

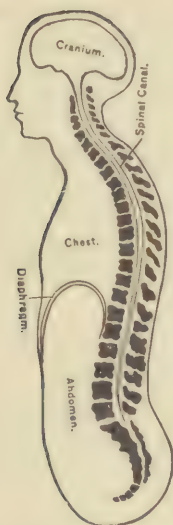


Fig. 2.
Cavities of the Body.

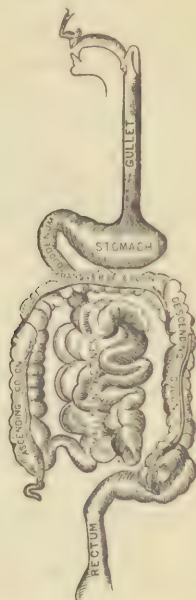


Fig. 3.
Alimentary Canal.

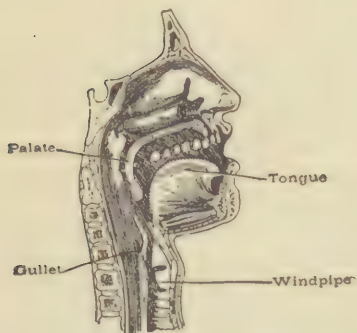


Fig. 4.
Section of Mouth, Nose
and Throat.

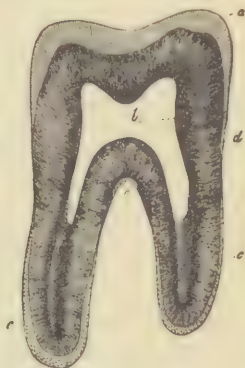


Fig. 5.
Section of a Tooth: a, Enamel;
b, Cavity; c, Roots; d, Body.

the dentine is the hard interior part; the surface layer of the fang or root is the *cement*; the *pulp* fills the small cavity within the tooth, in which are the blood vessels, nerves and a fatty substance.

53. (a) Thirty-two teeth in an adult, eight in each half of each jaw. (b) The milk teeth are the temporary teeth, twenty in number, and begin to drop out when the child is from five to seven years of age. They are forced out by the permanent teeth, the roots of the milk teeth being absorbed by the permanent teeth.

54. The two middle incisors of the lower jaw are the first to appear in the child; the wisdom teeth are the last to break through, between the seventeenth and the twenty-fifth birthdays.

The first permanent teeth appear behind the posterior milk molars, before any of the milk teeth are shed; viz., at six years, so that a child of six has twenty-four teeth,—twenty temporary and four permanent. The permanent teeth usually appear as follows:—

The first molars at the 6th year, sometimes called the “six year” molars.

The central incisors at the 7th year.

The lateral incisors at the 8th year.

The anterior bicuspid at the 9th year, replacing first milk molars.

The posterior bicuspid at the 10th year, replacing posterior molars.

The canines at the 11th to 12th year.

The second molars at the 12th to 13th year, sometimes called “twelve year” molars.

The third molars at the 17th to 25th year.

55. The teeth should be brushed at least twice daily, before breakfast and after the evening meal; the teeth should be brushed up and down, as well as from side to side; the brush should be of good bristle; warm water and a tooth paste or powder should be used; if this is done, it may not be necessary to use any wooden toothpicks or strong thread to remove the particles that may lodge between the teeth; the teeth are not in the class of nutcrackers, and should not be so used; be careful not to alternate hot and cold substances too near the

teeth, as the differences in temperature may cause a cracking in the enamel; twice or three times a year the dentist should be visited to remove the tartar, who will then discover any cavities in the teeth and fill them.

56. In the thorax or thoracic cavity we find the heart, the lungs, the œsophagus, and the larger blood vessels. Figs. 1, 2, 3, 7.

57. The abdomen contains the stomach, liver, the spleen, the pancreas, the kidneys, the bladder, the intestines, the many large blood vessels. Figs. 1, 2, 3, 7.

58. (a) The *viscera* comprises all the organs in the body cavity, these organs being enveloped by a semitransparent membrane made from the serum of the blood. (b) The *pleura* is the serous membrane of the thoracic cavity, and (c) the *peritoneum* is the serous membrane of the abdomen.

59. (a) The cavity back of the mouth and the throat region. (b) The *pharynx* narrows into the œsophagus just back of the larynx; is nine inches long, and one-half inch in diameter. Its function is to aid the movement of the food into the stomach. Figs. 3, 4.

60. (a) The *tonsil* is an oval body a half inch long and buried in the mucous membrane on either side of the root of the tongue. (b) Tonsilitis is infectious and may be spread from child to child by means of the common drinking cup, etc. The use of the tonsils is unknown.

61. Situated in all parts of the body are certain organs, called *glands*, which aid the work of nutrition in its various stages. Each gland consists of many active cells, all alike in general structure and function. The cells take the "raw material," as it comes to them through the blood and lymph, separate it, and excrete on their free surface the finished product. This general process is called *secretion*.

It is evident that if much material is to be secreted by a gland, many working cells are necessary. In order that many cells may be brought into as small a space as is possible, they are arranged on the surface of a tube or sack. Glands are of two types, *tubular* and *racemose*. If the general plan of arrangement is that of a tube, either simple or compound, the gland is called a tubular gland. The perspiratory glands are good ex-

amples of this type. If the cells are arranged along a surface which swells out at its upper end, like a sack, the gland is called *sacular* or *racemose*. The *sebaceous* glands are *racemose*. Either type may be *simple* or *compound*.

62. The glands of digestion are the *salivary glands*, the *gastric glands*, the *intestinal glands*, the *liver* and the *pancreas*.

63. (a) The *salivary glands* are three in number: the *parotid*, just below the ear; the *submaxillary*, between the lower jaw and the base of the tongue; and the *sublingual*, under the tongue. The juice of these glands, about a pint being secreted each day, contains the important ferment which acts upon the starches in the foods and changes it into sugar. It keeps the mouth moist and enables us to speak in comfort, dissolves salt, etc., and enables us to taste the substances and, in a way, to determine whether they are good or bad for the body.

(b) First, the chewing of the food breaks up the solid parts into much smaller pieces and enables the saliva to do its work much more effectively, so that every part of the starch may be reached by the ferments. The more thoroughly the food is masticated the more pleasant the food becomes to the taste, and the greater the working of the *salivary glands*, as well as the other glands of digestion.

(c) The *taste buds* or the organs of taste lie chiefly on the upper surface and edges of the tongue. The food which excites these end organs that are connected with nerve fibers to the brain, must be in solution,—another reason why the saliva should be given every opportunity to help dissolve the foods. Foods pleasant to the taste excite the other digestive juices, and therefore, the need for giving pleasant tasting foods.

64. A curved, conical bag, lying just below the diaphragm, being the enlargement of the alimentary canal. It is very elastic, and is thus able to hold food for long periods, from one to five hours, while the secreted juices act on it. At the upper end is the *œsophagus* opening, or *cardiac* opening, while at the lower end is the *pyloric* orifice leading to the small intestine. The involuntary muscles forming its muscular coat, arranged in three layers, keep the food in motion while the juices perform their work. It can hold from three pints to two quarts of food. Fig 6.

The inner coating of the stomach is the mucous membrane,

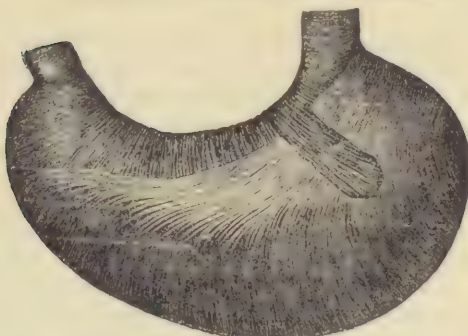


Fig. 6.

The Muscles of the Stomach.

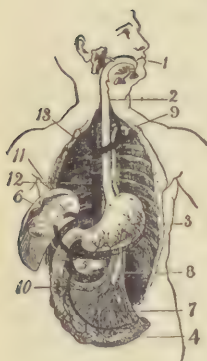


Fig. 7.

The various organs concerned in the conversion of food into blood.—
 1, Mouth and salivary glands; 2, the oesophagus; 3, the stomach; 4, a portion of the small intestine; 5, the pancreas; 6, the liver; 7, mesentery with lacteals; 8, receptacle of chyle; 9, the thoracic duct emptying its contents into the left subclavian vein; 10, branches of portal vein leading to liver; 11, an hepatic vein leading from the liver to the large ascending vein; 12, the large ascending vein cut off at its junction with the heart; 13, the large descending vein cut off in like manner.



Fig. 8.

A Gastric Gland.



Fig. 9.

Two intestinal Villi x 100: a, b, c, Lacteals; d, Blood Vessels.

which, as we have seen, furnishes the gastric juice. Next to this coating lies another, called the muscular coat, composed of involuntary muscular fibres, some of which run circularly, and others in a longitudinal direction. These expand to accommodate the food as it is introduced, and contract as it passes out. In addition, these fibres are in continual motion while food remains in the stomach, and they act in such manner that the contents are gently turned round from side to side, or from one end of it to the other.

By these incessant movements of the stomach, called the *peristaltic* movements, the gastric juice comes in contact with all parts of the food. We are, however, not conscious that these movements take place, nor have we the power to control them. When such portions of the food as are sufficiently digested approach the pylorus, it expands to allow them to pass out and it closes again to confine the residue for further preparation.

65. The *rectus abdominalis*, the *obliquus externus* and *internus*, and the *transversalis*.

66. (a) The gastric glands line the mucous membrane of the stomach. They yield pepsin, rennin, and hydrochloric acid, which dissolved in the watery fluid also exuding from the glands form the gastric juice, not less than three or four pints being secreted at each meal. Fig. 8. (b) Gastric juice is formed from the blood by something like five million microscopic tubelike glands completely covering the inside of the stomach. These glands are set off either by the presence of food in the stomach or by the taste and odor of food. Soups and meats increase the amount of the secretion of this juice and are, therefore, better foods at the beginning of a meal than at the end.

67. The *intestines* are composed of the *small intestine* and the *large intestine*. The small intestine is a very much coiled tube about twenty-five feet in length, and more than an inch in diameter. The food is moved along by the two layers of involuntary muscle that form its muscular coat. The opening into the large intestine at the lower right side of the abdominal cavity is by means of a valve. The *colon* and the *rectum* are the main parts of the large intestine. Figs. 1, 3, 7.

68. The *appendix* or *vermiform appendix* is a closed tube or sac projecting from the large intestine, from one to five inches

in length and about one-third of an inch in diameter. The interior of the tube is almost solid, the opening being no wider than a pin head. Appendicitis is the result of the inflammation of the appendix when food or any other substance clogs up this fine opening.

69. The *intestinal glands* are simple, tubelike in shape, standing side by side, with their mouths opening at the bases of the villi which stick out into the cavity of the intestine. These glands secrete about three quarts of a watery fluid containing substances that are of great importance in digestion, and without which indigestion results.

70. (a) A *ferment* is a substance formed by living cells and capable of acting on other foods without any changes being made or taking place in the ferment itself. (b) In the glands.

71. The *liver*, the largest gland in the body, lies immediately under the diaphragm. It is brownish red in color, and is about one half of the head in size. The five lobes contain thousands of lobules made up of cells that manufacture the bile. This escapes from the liver into the small intestine through the hepatic duct. The excess of bile is carried into the gall bladder for storage. The bile acts upon the fats and makes the emulsions.

72. (a) The *pancreas* or sweetbread, is a pinkish white gland, about half the size of the hand. It extends from the stomach end of the small intestine across the body back of the stomach. The pancreatic duct, composed of several smaller ducts, conveys the pancreatic juice into the small intestine. (b) The juice secreted by the pancreas, containing the most important of all ferments of digestion. One changes the starch into sugar, another changes the proteids into peptones, a third breaks up the acids into the fatty acids and glycerin for the soaps that are formed by the action of the bile. The pancreatic juice completes the digestive process as far as it relates to the digestive juices.

73. (a) *Chyme* is the partly digested food in liquid form that has been ejected by the stomach into the small intestine, (b) which when acted upon by the ferments of the pancreatic juices becomes a dark liquid mass of food material, composed of

peptones, soap, and sugar, and is now ready for absorption. This mass is called *chyle*.

74. A yellowish greenish liquid, secreted by the liver at the rate of more than a pint a day. The excess over the quantity used is secreted in the gall bladder, and when the bile duct become clogged and the bile escapes into the blood, jaundice results. The *bile* has no digestive power in itself, but it hastens the action of the other digestive agents. It also contains some of the waste matter of the body.

75. The peristalsis or peristaltic movement, a wavy contraction of the circular muscle, presses down the food. The other movement is the swinging to and fro of the several folds of the intestines by a rythmical contraction of the circular and longitudinal muscles. The motions are a projecting and a mixing one, and serve to complete digestion and to aid in the carrying off of the waste matter.

76. Food remains in the small intestine for a period of from five to fifteen hours, during which time the nutritious part is absorbed into the blood. The waste passes into the large intestine from which it is ejected. Failure to do so causes constipation. See answer 79.

77. (a) The lacteals consist of millions of minute vessels beginning in the villi and other parts of the intestine and unite into many threadlike tubes which meet to enter into the left thoracic duct. (b) The thoracic duct is a tube which leads into a large vein in the neck, and returns to the veins in the neck by means of the lacteals, that portion of the blood which is constantly oozing out of the capillaries throughout the body.

78. The *portal system* consists of the large portal vein with its tributaries beginning in the capillaries of the intestines, the stomach, and other abdominal organs, and its capillaries in the liver. All foods except the fats are carried from the villi to the liver.

79. The three processes by which the food after it has been acted upon by all the digestive juices, that is, the chyle, is absorbed into the body so that it can be utilized by the tissues are (a) *osmosis*, (b) *filtration*, and (c) *imbibition*. Osmosis is the tendency of two liquids of different density and separated by a thin membrane to mix. Filtration is the passing

of liquids through a membrane by pressure. Imbibition is the drinking in of a liquid by a cell.

80. The food is taken into the mouth, where it is masticated and the saliva from the salivary glands converts the starches into sugar. From there it passes into the œsophagus and then into the stomach, where the gastric juice, acting upon the albumins, forms peptones. The chyme then passes through the pyloric valve into the small intestine where the pancreatic juice and the bile perform their work, the latter emulsifying the fats, and allowing their absorption into the body. The villi and the lacteals then complete the work and the nutritious portions of the foods are absorbed into the body, while the waste passes into the large intestine and then out of the body.

81. (a) In the small intestine, and (b) in the large intestine.

82. The amount of gastric juices secreted is naturally limited and it can act upon a limited quantity of food in the stomach effectively. Moreover, the muscles, etc., do not get necessary rest, with the result that the food is undigested, and since the pyloric valve will not allow any undigested food to enter the small intestine, the stomach is overloaded. Headaches, nausea, and vomiting may follow. Besides these, the effect on the nerves is such that serious results may follow.

83. Very hot or very cold liquids or fluids should, at no time, be taken into the system, because they decrease the flow of the gastric juice. Too much water, more than one glass during a meal, tends to dilute the juices and causes a deterioration in quality. With but few exceptions no person has had his digestion increased or improved by the aid of alcoholic drinks; on the contrary, the effect has certainly been difficult and painful digestion, usually chronic.

84. (a) Boiled rice, raw eggs, potatoes, legumes, and boiled beef. (b) Hard boiled eggs, white bread, stewed oysters, and boiled cabbage.

85. The chewing of gum and tobacco causes an unnecessary use of the saliva, so that when the food is eaten, the quantity of saliva for real use is lessened. The taste of the tobacco is unpleasant and the habit is uncleanly and unhealthful because it lessens the natural appetite for food and the power of digestion.

86. The alcohol that is taken into the stomach is absorbed, and

taken by the portal vein directly into the liver, where the blood is over-stimulated, and over-action results. The bad effect of this is that a healthy supply of bile is not secreted. In addition to this, organic changes are made in the liver.

The disorders (in the stomach) due to the drinking of alcoholic beverages are both functional and organic. The lining of the stomach is affected, the digestive action impaired; it may be checked, or it may even be completely arrested, with vomiting following.

87. Tight clothing, or tight lacing, by constricting the body, prevents the proper flow of blood and the expansion of the digestive organs when the food is projected into them. Indigestion, or delayed digestion, results.

88. (a) The small intestine is lined with villi (Fig. 9), more than twenty thousand to the square inch. Each of these villi consists of a layer of cylindrical cells covering a network of blood capillaries surrounding a single lacteal. (b) The epithelial cells take up the food, the lacteal vessels take up the fats, the blood capillaries of the portal system leading to the liver take up the remainder of the food.

THE CIRCULATORY SYSTEM.

89. (a) *Blood* is the fluid circulating round the body by means of the heart and through the veins and the arteries. (b) It is composed of a colorless liquid called the plasma, in which float millions of white and red corpuscles.

90. (a) The *red corpuscles* form the greater part of the weight of the blood, there being about twenty-five millions of these corpuscles to a drop of healthy blood. The red color is given to it by the (c) *hemoglobin* which contains the iron, and thus enables the blood to carry the oxygen to all regions of the body, and to carry for exhalation about half of the carbon dioxid. (b) The *white corpuscles* are considerably less in number, there being only one white cell to about five hundred red ones. They vary in size from one-half to twice the size of the red corpuscles, and change their shape very readily. The white cells may be seen in the pus of blisters, etc. The white corpuscles have three important uses: they help to protect the body from harmful germs by taking them up, they aid the villi in the absorption of the food

from the intestine, and their composition aids in the clotting of the blood.

91. (a) The red corpuscles are formed in the red marrow contained in the ends of all long bones, these bones being numerous and found all over the body, and abundant throughout the interior of the other bones. (b) At the rate of several thousand a minute. (c) The small white corpuscles are the result of the division of cells in the numerous lymph glands throughout the body.

92. The *plasma* is the colorless part of the blood filtering out of the capillaries for the purpose of supplying the tissues with food. It supplies them with nourishment and at the same time carries with it the waste materials which form the greater part of the solids in the urine.

93. The work of the blood is as follows: (a) It carries the necessary and important oxygen to the tissues; (b) it regulates the temperature of the body; (c) it transports the food to the various regions of the body; and (d) it carries all waste matters to the organs that eject them.

94. Blood, which is entirely liquid, on escaping from a blood vessel, becomes somewhat of a solid. This is due to the proteid fibrin, composed of the white corpuscles. This hardening is called *clotting* or *coagulation* and prevents the flow of blood from the vessels.

95. Oxygen to the tissues, and carbonic acid gas, or carbon dioxid, for exhalation.

96. (a) *Scrum* is the clear, light-yellow watery liquid that separates from the fibrin in the coagulation or clotting of the blood. (b) The *fibrin* is the proteid substance, in very fine fibres, which hardens in coagulation, and thus forms the protective covering of the cut.

97. The *lymph* is the blood plasma filtered and diffused from the capillaries, and is found in all spaces in the body cavity and in the crevices between the tissues. It is transparent, colorless, and contains many white blood cells. It is conveyed by the lymphatic vessels towards the heart, and is poured into the venous system by the thoracic and right lymphatic ducts.

98. An adult of normal size and weight has about six quarts of blood in his body, half of which may be lost without causing

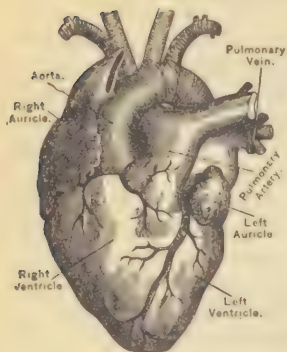


Fig. 11.

The Heart and its Blood Vessels.

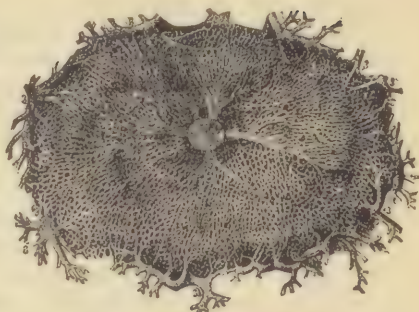


Fig. 13.

Cross-section of a Lobule of the Liver, with Capillary Network.

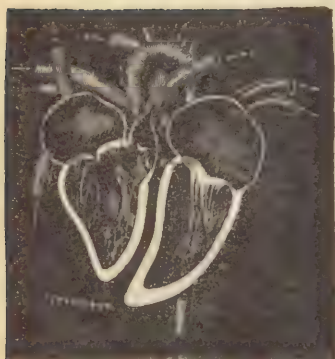


Fig. 12.

Cross Section of the Heart, Showing its Cavities, and the Blood Vessels. Arrows Indicate Direction of the Flow of Blood.



Fig. 14.

Lymphatics of the Hand.

death. In cases where there is this loss of blood, a saline solution can be injected to remedy the loss of blood.

99. *Anemia* is the deficiency of blood or of red corpuscles in the blood. Since the red corpuscles in the blood of a normal person approximate one-half of the volume of weight of the blood, and the hemoglobin in the red corpuscles enables the blood to carry the essential oxygen from the lungs to supply the tissues throughout the body, and the red corpuscles transport about half of the carbon dioxid from the tissues to the lungs to be exhaled, it is very evident then that in the absence of these all-important and essential red blood corpuscles the body is short of something that tends to purify and cleanse the system, and the person so conditioned cannot be in normal health. The thing to do is to consult a physician, who, in all probability, will prescribe a tonic containing iron in some form, in addition to a good, wholesome diet.

100. *Arterial blood* is the blood carried in the arteries, excepting the artery leading to the lungs, and is called *pure*, because it contains no carbon dioxid. Due to the oxygen it carries, it is rich red in color. *Venous blood*, on the other hand, is of a bluish hue, and can be seen through the veins in the wrist. The venous blood contains the carbon dioxid that is to be expelled from the body.

	<i>Venous Blood.</i>	<i>Arterial Blood.</i>
Color	Dark blue.	Scarlet.
Oxygen	8 per cent.	18 per cent.
Carbonic Acid Gas. . .	15 to 20 per cent.	6 per cent., or less.
Water	More.	Less.

101. A healthy body has no germs in its blood, excepting after a meal, when some germs are taken in with the food. With the proper digestion, these germs are ejected from the body in the waste materials. Eating an abundance of food that contains disease germs, as the tuberculosis germs in impure milk or cream, butter, etc., may cause a superabundance of these germs to find lodgment in the body, and cause bacterial disease.

102. (a) A dark red body, oval in shape, about an inch thick, and four inches broad by five inches long, partly covered by the ribs on the left side of the abdominal cavity, and behind the stomach. (b) Its actual and real function or functions have not been determined, but it has been found that it becomes enlarged a

few hours after digestion. It has been supposed that its function is the manufacture of ferments that pass directly into the blood, since it has no ducts or vessels leading to any organ.

103. (a) The *thyroid* is a flat two-lobed body, lying in front of the trachea just below the Adam's apple. That it is necessary is evidenced by the fact that animals from which it has been removed live but a very short time. The thyroids, or an extract from the thyroids, of the calf, or pig, are invaluable to those from whom the glands have been removed. (b) It is supposed that it manufactures a secretion that passes directly into the blood and has an important influence on the general growth and development of the mind and body.

104. The *circulatory system* consists of the heart, the lungs, the arteries, the capillaries, the veins, and the lymphatics. Fig. 10.

105. (a) The *heart* is an involuntary muscle, oval shaped, about the size of the clenched fist, with its apex directed downward and toward the left of the body. It is surrounded by a tough membrane, the *pericardium*, with a fluid, the serum, surrounding it in order to prevent injury to the heart. The interior of the heart is lined with a smooth, serous membrane, the *endocardium*. Figs. 11, 12. (b) It lies to the left of the body, between the lungs and almost in the center of the thorax, and is held in place by the great blood vessels attached to its various parts and by the fibrous tissue connecting the pericardium with the breastbone. (c) To pump the blood around the body.

106. The heart is divided into four cavities, two upper and two lower. The upper cavities are smaller than the lower and are called the *auricles*, while the two larger lower ones are called the *ventricles*. The auricles are thin-walled sacs which receive the blood and send it into the thicker-walled ventricles, which pump it out to the tissues. The auricles and ventricles are named according to their position, left and right. There are two openings into the right auricle, the ascending and the descending vena cava. There is no opening between the auricles, but valves between the auricles and the ventricles allow the passing of the blood between each auricle and the ventricle below it. Figs. 11, 12.

107. (a) There are four pulmonary veins which open into the left auricle and pass the pure blood from the lungs. (b) The aorta is a large artery leading from the left ventricle, and carry-



Fig. 10.

Circulatory System—Heart, Lungs, Arteries and Veins.
(Note the relative position of the organs in the body.)

ing the blood to all parts of the body except the lungs. (c) The pulmonary artery extends from the right ventricle to the lungs. Figs. 11, 12.

108. The blood, in passing from one sac to another in the heart, must pass in one direction only. This is due to the valves of the heart. The *tricuspid* valve between the right auricle and the right ventricle, consists of three membranes kept in place by tough cords extending to the walls of the ventricles. The *mitral*, or *bicuspid* valve is between the left auricle and the left ventricle, and consists of only two membranes, protected and kept in place in the same manner as above. There is a set of *semilunar* valves in the mouth of each artery leading from each ventricle to prevent the backward flow of the blood.

109. The action of the heart is a pumping one, contraction and pushing and then expanding. The auricles are filled with blood at the same time, they contract and push the blood into the ventricles, which immediately contract to push the blood into the arteries. A half second pause follows during which time the heart is filling for its next operation. The contraction is called the *systole*, and the pushing is called the *diastole*. The heart beat is the contraction and expansion of the walls of the heart.

110. (a) The *pulse* is the wave of blood produced by the alternate contraction and expansion of the heart in its pumping process. (b) In the adult the pulse or number of heart beats is about 75 per minute, while in the infant it is almost twice as much, 140 a minute. (c) In illness the pulse increases and the doctor gains valuable information from it. The strength and frequency of the pulse or heart beat in disease are affected by the poisons affecting the heart and the nerves controlling it.

111. A moderate amount of exercise is needed by all healthy individuals. The more one exercises, the greater is the need for a fresh supply of oxygen, and consequently the heart works the harder. Rest should follow exercise, in order to allow the heart to reduce its exertions to normal. Prolonged and severe exercise, if persisted in, causes the severer working of the heart to become chronic and enlargement of the heart follows.

112. The pulmonary artery leads from the right ventricle to the lungs; it is the only artery transporting venous blood. The aorta is the chief artery passing down the back of the heart and

branches off into many arteries to supply the internal organs. The carotid is a branch leading to the head and brain; the right iliac and the left iliac supply the right and the left legs, respectively, with blood.

113. (a) The largest artery is the *aorta*, and (b) the largest vein is the *pulmonary vein*.

114. The *veins*, like the arteries, contain three coats, the inner, middle, and outer coats. They are composed of more condensed connective tissue than the arteries, and are therefore more compressible, but less elastic and contractile. They are more numerous than the arteries, and communicate with each other freely in their course by interlacing branches.

115. The arteries carry the pure blood from the heart to the various organs and tissues that require nourishment and strengthening, while the veins carry the impure blood with its carbon dioxid for exhalation.

116. The lungs are connected with the heart by means of the pulmonary veins which bring the pure blood into the left auricle from the lungs. The pulmonary artery extends from the right ventricle to the lungs. The lungs form the purifying agents of the blood pumped by the heart around the body, and loaded with the carbon dioxid, after which the heart receives the purified blood, again to be pumped around the body.

117. (a) The very fine, hairlike blood vessels that connect the arteries with the veins, and thus enable the blood to make a complete circulation. They are the finest branches of each terminal artery, and form a fine network all over the body. The walls of these are so thin that the oxygen and nutriment easily pass through while the waste passes into the blood and is carried along for ejection by the proper organs. (b) The functions of the capillaries are: (1) to connect the veins with the arteries; (2) to allow the oxygen and the chyle to pass through to the tissues; (3) to permit some plasma to escape to keep the supply of serum sufficient; and (4) to allow the white corpuscles to escape and help kill the germs and carry along the waste matter from the tissues.

118. The blood vessels are named according to their location and function: e. g., the *hepatic* are those of the liver, the *renal*, those of the kidneys, the *cardiac*, those of the heart, the *radial*,

those along the radius, and the *mesenteric*, those of the intestines.

119. (a) The *lymphatics* are minute vessels forming, in many parts of the body, a thick network, and uniting to form larger trunks and ducts. These vessels are found in the many spaces that exist among the tissues and organs. The work of the lymphatics is to return to the veins sufficient blood to make up for the quantity lost by the oozing from the capillaries. Any substance injected beneath the skin is taken up by the lymphatics and spread rapidly through the system. This is the reason for the quick working of the vaccine germs, hypodermic injections and the poisons of the snake family. Fig. 14.

(b) The thoracic duct. See answer 77.

120. Pressure on the lymphatics due to the forcing of the blood in the capillaries, the flexion of muscles, the rubbing of parts, any exercise or massage, will cause the lymphatics to push along their contents.

121. Course of the blood: Right auricle, right ventricle, pulmonary arteries, lungs (capillary system), pulmonary veins, left auricle (Pulmonary Circulation); left ventricle, aorta, capillary networks in all parts, venæ cavæ, right auricle (Systemic Circulation); capillaries of spleen, pancreas, stomach, intestines, portal vein, capillaries of liver, hepatic vein, inferior vena cava, right auricle (Portal Circulation).

122. The blood circulates through the larger arteries ten times as rapidly as through the very small ones; in the capillaries the flow is less than one-five-hundredth as fast as in the large aorta. This of course is estimated in the person who does a normal amount of work and exercise. With greater energy the flow is increased because of the greater consumption of oxygen.

123. (a) A hemorrhage is the flow of blood caused by the bursting or breaking of some blood vessels. (b) By means of a ligature or a tourniquet. Usually if the bursting is of a small vessel, the fibrin in the blood will cause a clotting, but where the wound is larger, mechanical means must be adopted. A pressure of the finger will often cause the flow to stop; if not that, then the members or region near the hemorrhage must be constricted so that the blood vessel must be closed and the blood will be prevented from continuing its flow.

124. It is evident that good health depends upon the con-

tinuous normal flow of the blood and the functioning of this important fluid. If then, any tight clothing is worn, there will be a compression of the blood vessels and the circulation will not be normal. Tight corsets, tight garters, tight hat bands, all of these prevent the normal flow of the blood. Then too, a moderate amount of exercise should be indulged in in order to make sure that the blood will flow normally. It is a good thing to quicken the flow of the blood by some rapid, fairly strenuous exercise, as this will in a large measure keep the lymphatics clear.

125. The arteries of the skin become enlarged, and the face becomes red due to the large amount of blood that is sent to the surface. Then too, the body may become colder, because the heat of the blood near the surface is carried off so quickly, when it should be conserved. As a result we find that alcoholics do not and cannot stand the cold weather. Fatty degeneration of the heart, apoplexy, paralysis, considerably reduced vitality to fight the infectious diseases, result.

126. William Harvey, in 1619.

127. Tobacco both quickens and enfeebles the heart. In habitual users, it gives rise to undue palpitation of the heart, this palpitation being so extremely rapid at times. In other cases, the effect is a weakening and depressing of the heart action.

128. Heart disease is an ailment that should be prevented by all means. Overindulgence in exercise, overstimulation by means of liquors and narcotics, etc., should be avoided, lest fatty degeneration of the heart, valvular diseases, etc., may result. Care should be taken not to indulge in the so-called heart disease cures that are advertised by patent medicine venders. Owing to the gradual weakening of the system due to increasing old age, some form of heart disease is prevalent among persons of sixty years or over, but it should be carefully avoided in the younger aged. Intense application to business is a frequent cause among those between thirty and fifty years of age. A moderate amount of food, plenty of rest, and the care of a physician are the requisites in all cases. Not only is there considerable loss of life each year as a result of cardiac diseases, but the economic loss to the nation is considerable.

THE BONES AND THE SKELETON.

129. (a) *Bone* is a hard dense tissue composed of calcium salts and organic materials, forming the principal portion of the human skeleton. (b) Protection of the internal organs, support of the body, and allowing of bodily movement. The red blood corpuscles are manufactured in the red marrow of the long bones and others. Fig. 19.

130. Bone is composed of both animal, or organic, matter and mineral matter, the latter chiefly carbonate and phosphate of calcium or lime. The mineral matter may be shown by burning a bone for a time in a hot fire, when the animal matter will be consumed and nothing but the mineral ashes will remain. By placing a bone in strong acetic, nitric or hydrochloric acid diluted, the mineral matter will disappear in solution while the spongy animal matter will remain.

131. *Bone* consists of two parts, the outer compact or hard bone, and the interior spongy cancellous bone. The whole bone is covered with a tough membrane called the *periosteum*, which allows of the attachment of the muscles and tendons, and renews the portions of bones that are removed as a result of operation. In the middle of the shaft of the bone is the *medullary canal* which is filled with white fatty *marrow*. A cross section of a bone will show, when magnified, numerous small holes called *Haversian canals*, through which the fine blood vessels and nerves run. The canals are surrounded by *lacunae* which are filled with cells nourished by the blood that escapes from the Haversian canals. Fig. 19.

132. *Cartilage*, or *gristle*, is a tough white substance, the forerunner of bones, and is gradually changed into bone as the child grows older. The cartilage also serves to connect the ends of bones to their shaft until about the seventeenth or eighteenth years.

133. (a) The *skeleton* is the bony and ligamentous framework of the body. (b) It gives firmness and strength to the body and provides for the covering by means of the muscles and the skin. Fig. 15.

134. The three parts of the skeleton are: (a) the *skull*, or bones of the head, numbering 28; (b) the *trunk* with its

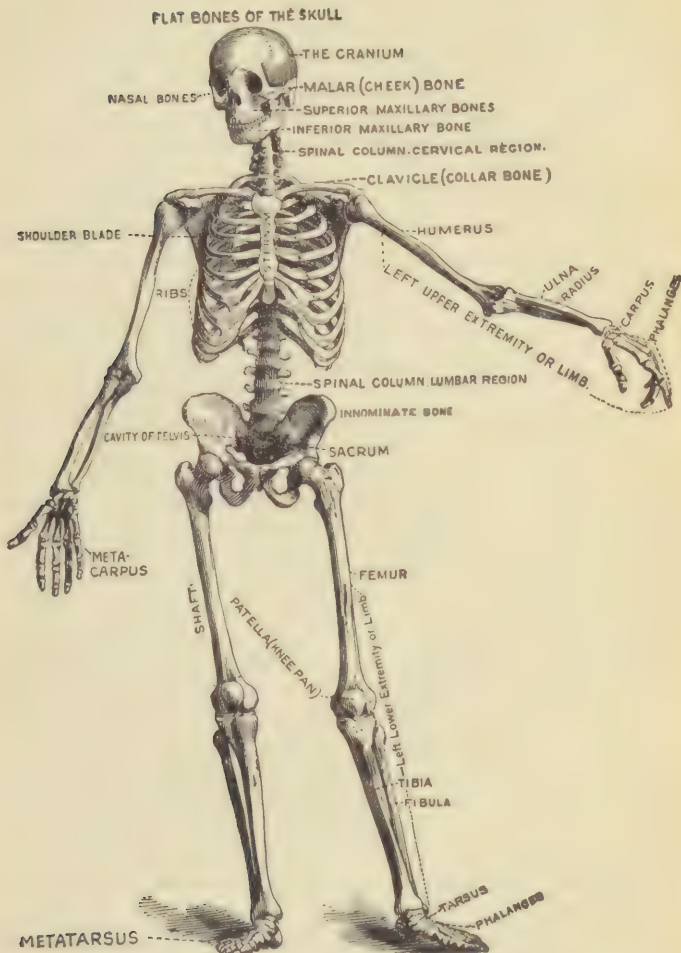


Fig. 15.

Bones of the Skeleton.

54 bones; and (c) the limbs, the *upper extremities*, 64 bones, and the *lower extremities*, 60 bones.

135. The Bones of the Skeleton.

I—The Head (28 bones).

1—The Skull (8 bones).

1 frontal (forehead).

1 occipital (back of head).

2 parietals (side of head).

2 temporals (temples).

1 sphenoid (wedge shaped).

1 ethmoid (through which the branches of the olfactory nerve pass to the nose).

2—The Face (14 bones).

2 nasal (the bridge of the nose).

2 malar (check bones).

2 lachrymal (forming a part of the orbit).

2 palate.

2 turbinated (one on each side of the outer wall of the nasal cavities).

2 upper maxillary (jaw).

1 lower maxillary.

1 vomer (separating the nostrils).

3—The Ears (6 bones).

Malleus (mallet).

Incus (anvil).

Stapes (stirrup).

II—The Trunk (54 bones).

1—The Spinal Column (26 bones).

7 cervical (neck) vertebræ.

12 dorsal (back) vertebræ.

5 lumbar (small of the back, or loin) vertebræ

Sacrum.

Coccyx.

2—The Ribs (24 bones).

12 on each side; the upper seven being the "true" ribs, and the lower five, the "false" ribs.

3—The Hyoid (supports the base of the tongue).

4—The Sternum (breast).

5—The hip bones (2).

III—The Limbs (124 bones).

1—The upper limbs (64 bones) 32 in each of the upper limbs).

2 clavicle (collar).

2 scapula (shoulder-blade).

2 humerus (arm).

2 ulna (forearm).

2 radius (forearm).

16 carpals (wrist).

10 metacarpals (palm).

28 phalanges (3 in each finger, 2 in the thumb).

2—The Lower Limbs (60 bones, 30 in each of the limbs).

2 femur (thigh).

2 patella (knee-pan).

2 tibia (leg).

2 fibula (leg).

14 tarsals (instep).

10 metatarsals.

28 phalanges (2 in the great toe, 3 in each of the others.)

136. Bones are divided, according to shape, into five classes: (a) flat bones, as the ribs, the shoulder blades; (b) the long bones, as those in the legs and the arms; (c) the short bones found in the wrist and the ankles; (d) the irregular bones, including the sphenoid, and the vertebræ; and (e) the sesamoid bones, like the patella, formed in the region of joints by friction or pressure.

137. Hollow bones are stronger than solid bones and do not buckle or bend, thus giving added strength to the skeleton.

138. The bones of the child of five are composed largely of gristle, and therefore, when the child falls, it does not sustain any fractures; while the bones of the adult are made of calcareous matter, and a hard blow against them will cause a fracture.

139. "The power of bone to resist decay is remarkable. . . . The teeth resemble bone in their structure, but resist decay longer. . . . The bones differ at different ages, and under dif-

ferent social conditions. In the disease called 'rickets,' quite common among the ill-fed children of the poor in Europe, there is an inadequate deposit of the mineral substance, rendering the bones so flexible that they may be bent, almost like wax. In females and weak men the bones are light and thin, while in a powerful frame they are dense and heavy. Exercise is as necessary to the strength of bone as to the strength of muscle; if a limb be disused, from paralysis or long sickness, the bones lose weight and in strength as well as the soft parts. Bone is said to be twice as strong as oak, and, to crush a cubic inch of it, a pressure equal to 5,000 pounds is requisite."

140. Cartilage, or gristle, consists of round or oval cells, imbedded in a matrix, which varies in the three forms of cartilage found in the body. They are (a) hyaline, found on the articular ends of bones, and the cartilages of the nose and the larynx; (b) white fibro-cartilage, found in the disks between the vertebræ; and (c) yellow fibro-cartilage, which differs from the other two in structure, and which is found chiefly in the external ear.

141. Bones increase first in length by ossification, the cartilage growing in advance of the ossifying process; and second in circumference by deposition of new bone from the deeper layer of the periosteum.

142. (a) A fracture is a break in a bone. (b) A *compound fracture* is one in which the ends of the broken bone protrude through the skin. (c) A *dislocation* is the forcing out of place, forward, backward, or to a side, of a bone. (d) A *strain* results from the stretching or tearing of the ligaments of a bone. (e) The *sprain* differs from the strain only in its severity.

143. Because of the fact that they are not bone, but gristle, and easily bend or assume different shapes, the load carried by children should be very light. Infants should not be permitted to walk until they are about eighteen months or two years of age, and sufficient bone has developed in their legs and thighs to sustain the weight of their bodies.

144. Tuberculosis of the bones is caused by the tuberculosis germ finding lodgment in the bone and multiplying rapidly. Curvature of the spine and hunchback may be the result of the consumption of bone. *Rickets* is found in children whose diet

has consisted almost entirely of milk, so that but little calcareous matter has been deposited in the body.

145. See answer 131.

146. See answer 135.

147. It is very important that the contents of the skull be protected as much as possible, since it contains the most important organs in the body, the brains, the seat of all intelligence. Therefore, it should have the greatest protection. This is afforded by the rounded shape of the skull, the round bones forming the skull being much stronger than flat bones. The rounded skull can bear hard blows much better than can flat bones. The joining, the suturing, also adds strength.

148. The bones of the skull are dove-tailed together by what are called *sutures*, such suturing making the bones fixed with relation to one another.

149. See answer 135.

150. See answer 135.

151. See answer 135 and Fig. 15.

152. See answer 135.

153. The *spinal column*, or "backbone," or axis, consists of twenty-four small bones, called *vertebræ*. These unite below with the sacrum, which forms the base of the pelvis, and upon which the weight of the body rests; joined to the lower end of the sacrum is the *coccyx*, also a small bone. The *vertebræ* are divided into three classes; the first is the neck, and contains the seven cervical *vertebræ*, another the dorsal twelve *vertebræ*, to which the ribs are attached, and the third five lumbar *vertebræ*, forming the "small of the back." Figs. 16, 20.

154. (a) The *dorsal bones* are those *vertebræ* to which the ribs are attached. (b) *Twelve*, numbered from top downward. (c) The first seven pairs of ribs are joined to the breast bone, the sternum, by pieces of costal cartilage, thus forming the body arch. The eighth, ninth, and tenth pairs are each joined by cartilage to the cartilage of the rib preceding, and the last two pairs are free in front, thus giving that peculiar shape, open bottom, of the rib cavity.

155. The *ribs* are twenty-four in number, arranged in twelve pairs, though there is sometimes a thirteenth pair, and sometimes only eleven pairs. For the joining of the ribs to the

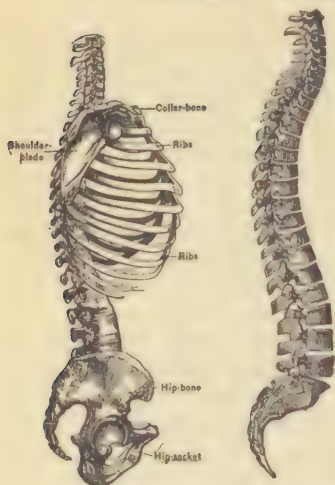


Fig. 16.
Bones of the Trunk and the Spinal Column (side view).

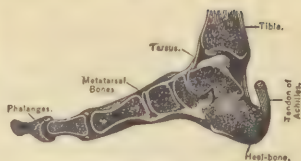


Fig. 18.
The Bones of the Foot.



Fig. 19.
End of a Long Bone, cut Lengthwise.



Fig. 17.
The Skull Bones:
1, Frontal 2, Parietal; 3, Temporal; 4, Sphenoid; 5, Malar; 6, Lachrymal; 7, Nasal; 8, Upper Maxillary; 9, Lower Maxillary.

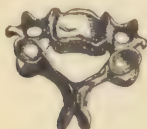


Fig. 20.
A Vertebra.

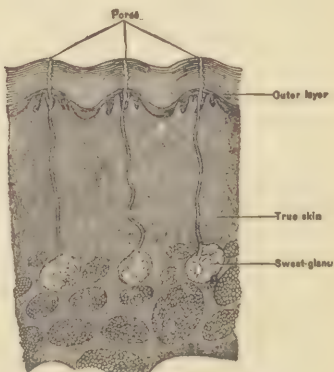


Fig. 21.
Section of Skin.

sternum see the preceding answer. The last five pairs are sometimes called the *false ribs*; the last two pairs being called *floating ribs* because of the absence of joining. All the ribs are articulated to the spinal column, and have considerable freedom of motion, rising and falling in breathing. They increase the chest cavity when they rise, because they are brought more nearly at right angles to the backbone. Tight lacing makes the ribs more curved and shorter, thus lessening the size of the thoracic cavity and allowing of less chest expansion. The ribs with the muscles covering them form a valuable protection for the important organs of the viscera.

156. The *pelvic arch* is the arch surrounding the pelvis, or pelvic cavity. The *pelvis* consists of the sacrum, the coccyx, and the two innominate bones. The *sacrum*, so called because it was the sacred bone used in sacrifices, consists of five solidly united and modified vertebræ. The *coccyx* consists of four loosely joined vertebræ, modified in form. In early life the *innominate* are composed of three bones, the *ischium*, or seat-bone, the *pubes*, and the *ilium*, or hip-bone. The place where these three unite is in the form of a deep cup which makes a socket for the head of the femur.

157. Horse-riding by young ladies, the oblique position in writing, the use of the sewing-machine, the certain attitude required in many of the games and sports, the use of high-heeled boots and shoes by young women and children, because they throw the body too far forward; the "forward attentive" position and attitude of children in the schoolroom, the carrying of heavy packages, and of too many school-books, because they all tend to throw the body out of the natural poise.

158. (a) *Cartilage*, or *gristle*, is that whitish substance seen at the ends of the bone when a fresh joint is opened. All bones are at an early stage cartilage, but the kind of cartilage seen in the joints and some other parts of the body never changes into bone, and is, therefore, called *permanent cartilage*. The cartilage at the ends of the bones renders the movements of the joint very easy, and acts as a cushion. (b) The *ligaments* are bundles or bands of fibrous tissue, pliable, elastic, very strong, connecting the bones at the joints in a manner similar

to the hinges on a door. They vary from the very thin and ribbon-like to the thick heavy bands, or cords. Some pass from one bone to another, while others surround the joint as with a cap. They are unyielding, so that, when violence is brought to bear in the vicinity of a joint, the bone may be broken, while the ligaments is uninjured. When the material is strained or lacerated by an accident, a *sprain* results, very often as serious as the fracture of the bone. (c) *Tendons* are fibrous bands or cords by which muscles are usually attached to the bones, or other muscular attachments. Tendons may be distinguished from nerves, which they resemble so much, by their pearly white glistening appearance and their strength. (d) The *synovial membrane* is a thin membrane making a compressed closed sac, moistened by a colorless liquid, similar to the white of an egg, and called the *synovial fluid*.

159. (a) A *joint* is the point of union of two or more bones. It is also called an articulation. (b) The joints of the cranial bones, the cranial sutures, are *immovable*, that is the bones joining there cannot be moved; while the *movable* joints are found mostly in the limbs where the greatest freedom of motion is required. The most completely movable joint is the ball and socket joint, as illustrated in the hip and in the shoulder. In the *mixed joints* the motion is produced not by the gliding or the turning of one bone on the other, but by both bones being fastened to a very strong cartilage, which, in yielding, permits of motion. These mixed joints are found in the vertebræ.

160. The *ball and socket joint*, found in the shoulder and in the hip; the *gliding joint*, seen in the wrist and in the ankle; the *hinge joint*, in the elbow and in the knee, and the *pivot joint*, the joining of the atlas and the axis. It is to be noticed particularly that where the greatest freedom of motion is required, we have the ball and socket joint, and that the joint is suited in all cases to the kind of movement necessary.

161. See answer 160.

162. See answers 349, 350, 351, and 352.

163. It is probable that alcoholic drinks and narcotics do not affect bone growth and development directly, but since they interfere with the proper nourishment of all parts of the body, it is a natural consequence that the bones will suffer from this

deficiency in nourishment. It is a known fact that the use of alcohol or of drugs arrests the development of the body.

164. Hold the head erect with the chin somewhat near the neck; expand the chest in front; throw the shoulders back, keeping them the same height on both sides; maintain the natural curves of the spine. Do not get into the habit of lounging or slouching while sitting. Watch your posture in writing, in reading, in sitting in a chair or on a bench with or without a back.

165. The bone is a living tissue, it is a growing part of the body, and needs proper nourishment, rest, and exercise like all the other organs and tissue of the body. Good food, fresh air, proper exercise, not lifting too many or too heavy weights, all of these will aid in the development of a good, strong skeleton.

THE MUSCULAR SYSTEM.

166. (a) The *muscles* are organs composed of contractile tissue or lean meat. (b) Through their contraction locomotion is afforded; they give shape to the body, and they protect the internal organs. (c) Their contractility, that is they may become shorter in length and thicker at the same time.

167. (a) *Voluntary* muscles are those that will act as a result of an act of the will. (b) The *involuntary* muscles are those that cannot be controlled by the will, but which act as the result of some internal stimulus.

168. The *involuntary* muscles are often called *striated* or *plain* muscles, because of the shape and appearance of their cells. They are found in all the internal organs and in the skin, where they are beyond the control of the will and perform their work when they have the right stimulus. They are reddish pink in color, surrounded by a transparent membrane attached to the adjacent muscles. The fibers, which are the important constituent of the muscles, have the shape of long rods, varying in length from about an eighth of an inch to about two inches, and are so fine that a dozen would not be as thick as a black hair. Between these fibers are the arteries, capillaries and veins for the purpose of supplying oxygen and food. Fig. 25.

169. *Voluntary* muscles, those that act as an expression of the

will, are connected with the bones, and also with cartilages, ligaments, skin, and other structures. This connection is made either by muscular tissue or by means of white, firm *tendons*, or *sineus*. The voluntary muscles are made up of bundles of fibers, each fiber tightly enclosed in a structureless membrane called *sarcolemma*, very elastic and allowing of the free movement of the fiber. The several bundles of fibers are surrounded, as is also the entire muscle, by connective tissue, holding all the fibers and bundles together in one muscle. A muscle fiber of a voluntary muscle, under the microscope, is shown to have alternate dark and light cross stripes; voluntary muscle is, therefore, also known as *striped*, or *striated* muscle. Fig. 24.

170. (a) The part of the skeleton or bone to which the inner end of the muscles is attached is the *origin*, while (b) the *insertion* is that to which the outer end is fixed. (c) *Tendons*, or *sineus*, are the extremities of muscles, and are firmly fastened upon the bone. They are very strong, and of a silvery whiteness. They may be felt just beneath the skin, in certain parts of the body, when the muscles are being used, as at the bend of the elbow or knee. (d) *Tendon of Achilles*.

171. Muscles occur in one, two, and even three layers over the bones. They are attached to bones, either directly or by means of a tendon or white cord which runs along the entire muscle. There are about 400 voluntary muscles in the human body.

172. Muscles are divided, according to their function and action, as follows: (a) *flexors*, as on the palm side of the hand and the arm, the back of the leg, which bend the limb; (b) the *extensors* which have the opposite kind of action and, therefore, lie on the opposite side; (c) the *abductors*, which pull a limb or parts outward, and (d) *adductors*, which perform an action opposite to that of the abductors, seen in the breast muscles; (e) the *sphincters*, which are round muscles around the mouth and the eyes.

173. One's appearance and countenance depend upon the action of the various features of the face. These depend upon the actions of the muscles that control the eyes, the mouth, the nose, etc. Frowning, pouting, crying, or any other act indulged in often, trains the muscles that cause a certain expression, and

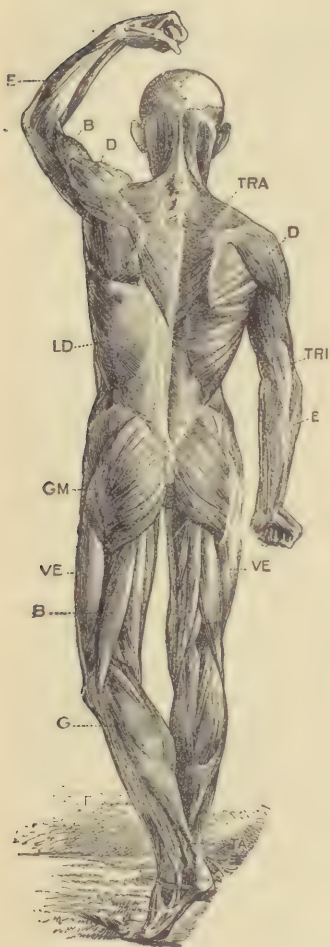


Fig. 22.

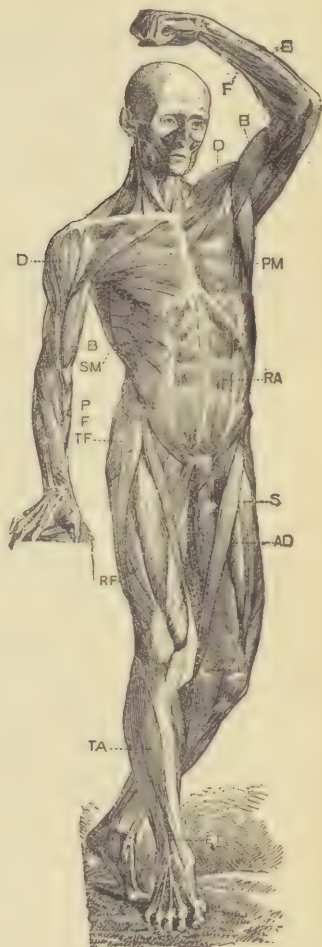


Fig. 23.

Muscles of the Body (superficial layer).
 Posterior View. Front and Side View.

Fig. 22

E, extensors of the hand.
B, *biceps* muscle, flexor of arm and forearm.
D, *deltoid*, raises the arm and moves it backwards and forwards.
TRA, *trapezius*, draws back and raises shoulder.
TRI, *triceps*, extensor of forearm.
LD, *latissimus dorsi*, assists in respiration by moving the ribs.
GM, *gluteus maximus*, moves the thigh backward and outwards.
VE, *vastus externus*, extends the leg.
B, *biceps* of thigh, flexor of leg.
G, *gastrocnemius*, extends the foot.
F, flexors of the foot.
TA, *Tendo Achillis*.

Fig. 23

E, extensors of the hand.
F, flexors of the hand.
B, *biceps*, etc.
D, *deltoid*, etc.
PM, *pectoralis major*, draws the arm forwards and inwards.
P, *pronator*, rotates forearm inwards.
SM, *serratus magnus*, assists in respiration.
RA, *rectus abdominis*, that makes tense the abdominal walls.
TF, *tensor femoris*, that makes tense the connective tissue of thigh, and moves the thigh outwards.
S, *sartorius*, flexes the leg.
AD, adductor group of thigh muscles.
RF, *rectus femoris*, one of the group of extensor muscles of thigh.
TA, *tibialis anticus*, moves foot forward.
ET, extensors of the toes.

these muscles become habituated to perform these actions on the slightest stimulus. Fig. 26.

174. Exercise strengthens the muscles, reduces the amount of fat, makes them strong and well developed, and gives fine shape to the body. The action of the muscles generates energy, causing the oxygen to be used up and requiring replenishment of oxygen, and, therefore, a good circulation of the blood.

175. *Occipito-frontalis, temporals, masseters, buccinators, orbitals. Sterno-cleido mastoid and trapezius.* Figs. 23, 26.

176. The chest muscles (*pectoralis major and minor*), the broad of the back (*latissimus dorsi*), the rib muscles (the *intercostals*), the diaphragm, the abdomen (*rectus abdominalis*), *obliquus externus and internus, transversalis*, the loins (*lumburum*), the vertebral (*erector spinae*). Fig. 23.

177. (a) The shoulder (*deltoid*), the arms and forearms (*biceps and triceps*), the hand and fingers (*flexors and extensors*), *pronators*, and *supinators*. Fig. 23.

(b) *Glutei, iliac, psoas, rectus, vastus externus and internus, sartorius biceps, gastrocnemius, tibialis.* Fig. 23.

178. Pushing and punching the bag, pushing the ball, raising weights, pulling weights, bending the body till the floor is touched, rising on tip toes, stretching the arms upward, bending the knees, lying on the back, swinging the arms in a circle, etc.

179. Massaging consists of pinching, squeezing, pressing the muscles, kneading the muscles in such ways as to cause a greater and freer circulation of the lymph and the blood. The circulation is stimulated, greater amount of oxygen consumed, more oxygen required, and a healthier flush appears.

180. The will, drugs, electricity, mechanical means.

181. The nicotine in the tobacco causes the involuntary muscles of the small blood vessels to contract, thus shutting off the nourishment intended for the growth and development of the muscles.

182. Alcohol changes the muscles into fat, making them flat and flabby, and not chemically strong enough to perform their usual functions.

THE RESPIRATORY SYSTEM.

183. (a) *Breathing* is the process of inhaling the air into the lungs and expelling it after it has made the circuit around the

body. Those processes, collectively, by which the system receives oxygen, and expels from the system the carbon dioxide due to the chemical changes going on in the body. (b) The carrying of the oxygen to the various regions of the body and the expulsion of the poisonous carbon dioxide.

184. The nasal passages, the pharynx, the larynx, the trachea, and the lungs. Figs. 27, 28, 29, 30.

185. The *nasal passages* are the two channels within the nose, separated by means of the nasal septum; they open behind at the upper and back part of the mouth. These channels are lined with a mucous membrane in which are glands that secrete the mucus. The mucus, with the small hairs that line the nostrils, serves for the purpose of purifying the air that is inhaled through the nostrils, so that none but clear air is inhaled through the windpipe. Nerves of smell lead to the special cells in the membrane, making the nose the special organ of smell. The nasal duct permits the tears to escape without running down the cheek after having performed the function of bathing the eye-ball.

186. Back of the tongue, and formed by the union of the nasal passages and the mouth, is a large cavity, called the *pharynx*. The pharynx is connected with the middle ear by means of the *eustachian tube*. The *esophagus* and the *larynx* open from the lower part. The *tonsils* are found there on either side of the root of the tongue. The *soft palate* and the *hard palate* are in the back of the mouth, just in front of the pharynx, from the former of which hangs the *uvula* into the pharynx. Fig. 30.

187. The *larynx* is formed of two large pieces of cartilage and several small ones, just top of the windpipe. The *thyroid*, forming the *Adam's apple*, projects from the large cartilage. Within the pharynx are numerous cells with slight projecting *cilia*, whose work is to restrain the germs and dust from passing down into the windpipe. The *glottis* is a narrow slitlike opening from the pharynx into the larynx, with the *epiglottis* attached in front of it. Fig. 30.

188. The *vocal cords* are the folds of lining membrane of the larynx opening of the glottis, these cords being rendered more or less taut by muscles.

189. (a) *Voice* is caused by the stretching and contraction of the vocal cords and the passing of the air through the orifice



Fig. 24.

Voluntary Muscles.

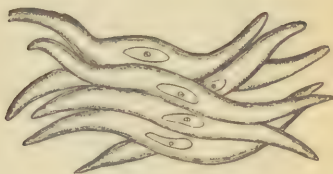


Fig. 25.

Involuntary Muscle (fibres separated to show structure and form).

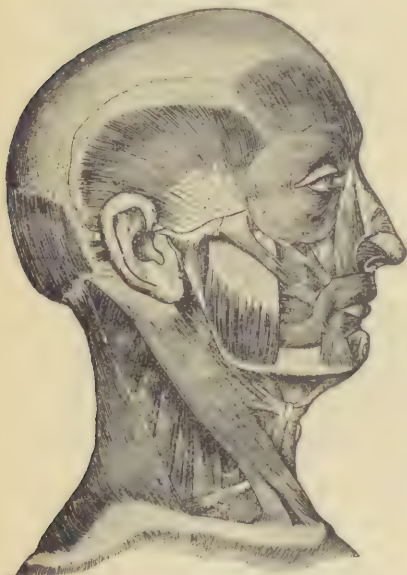


Fig. 26.

Muscles of Expression or Muscles of Face.

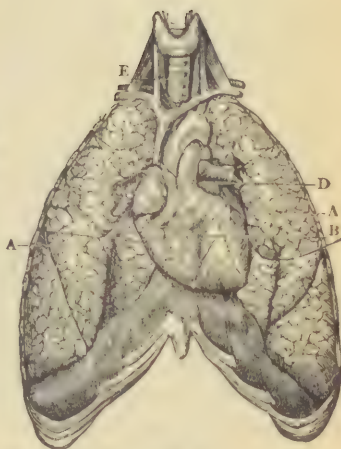


Fig. 27.

Organs of the Chest:

A, The Lungs; B, the Heart; D, the Pulmonary Artery; E, the Trachea.

made by these vocal cords, causing them to vibrate. When the vocal cords are stretched the opening is very small. The longer the cords, the less frequently they vibrate when the air rushes out between them, and the lower the voice. For this reason women have shriller, higher voice. The *pitch* of the voice depends upon the number of vibrations per minute, measuring from 144 in a bass voice to 1,980 per second in the highest note, five and a half octaves above. (b) The loudness of the voice depends upon the force with which the air is expelled through the larynx. In whispering the opening is so wide that there is almost no vibration of the cords. The quality of the voice depends not only upon the force of the expulsion of the air, but also upon the shape of the mouth, pharynx and larynx.

190. (a) The *trachea*, or windpipe, is a tube about four inches long and one inch in diameter, extending from the larynx to near the center of the chest. Here it divides itself into two parts, called the *bronchi*, which branch out and help form the lungs. Figs. 27, 28.

191. The lungs are two spongy masses, formed from the bronchi and their tubular branches, there being two of them, the right being slightly larger than the other. The apices of the lungs lie just back of the collar bone, their bases resting on the diaphragm. The *pleura* is a thin membranous covering of the lungs. The *bronchial tubes*, or the branches of the bronchi, end in groups of air spaces or air sacs. Figs. 27, 28, 29.

192. The act of *breathing* has two parts, (a) the inspiration, or taking into the lungs the fresh and purer air, and (b) the *expiration*, or breathing out of the impure air. In the former, the chest extends in its length, breadth, and height. The downward motion is caused by the pushing out of the internal diaphragm. With every inspiration the diaphragm contracts, and becomes almost level, thus enlarging the capacity of the chest.

193. The air enters the lungs through the nose or the mouth, by atmospheric pressure caused by the enlargement of the cavity of the chest, either by the descent of the diaphragm or because of the elevation of the ribs, which, in the former case makes the chest wider, and the chest deeper in the latter case. The lungs expand with the chest and the air rushes through the trachea, filling the enlarged lungs. In the expiration the

diaphragm returns to its former position, the elastic walls of the thorax recoil, the elastic lungs recoil, the intercostals contract, and the ribs become depressed, thereby causing the chest to become narrower and shallower. The abdominal muscles contract, and the abdominal organs press on the under side of the diaphragm, and the air is forced out through the trachea.

194. The inspired air and the blood are not in contact, as they are separated from each other by the walls of the air-cells and the blood-vessels. The interchange takes place because of the property of the moist animal membranes, which enables them to transmit gases through their substances. This is known as gaseous diffusion. The walls of the cells and vessels offer no obstacle to this process.

195. Breathing consists of the inhalation, or breathing in, and the exhalation, or breathing out. Breathing is at the rate of about fifteen times per minute. Exercise increases the rate, the more violent and strenuous the exercise the greater the rate; while in sleep the breathing is much slower. The breathing, of course, depends upon the consumption of oxygen by the tissues and organs, the consumption being considerably less during sleep and rest than during exercise and work.

196. (a) During ordinary calm respiration, we breathe eighteen times per minute, allowing the passage of twenty cubic inches of air to pass in and out of the lungs with every breath. In other words, more than ten pints of air is taken in each minute. This is equivalent to about thirteen cubic feet, or seventy-eight gallons, per hour. (b) The lung capacity is the difference between the chest measurement after the deepest exhalation and the chest circumference after the deepest and most forced inhalation. A more accurate measurement may be made by filling a two-gallon jar with water, turned bottom upward, and breathing into the water filled jar and displacing the water with the exhaled air. The amount of water displaced from the jar will accurately measure the amount of lung capacity; that is, after the deepest inhalation after following the deepest exhalation.

197. The three diseases which more commonly affect the lungs, as the result of exposure, are *pneumonia*, or inflammation of the lungs, affecting, principally, the air-cells; *bronchitis*, an inflam-



Fig. 28.

Larynx, Trachea and Bronchial Tubes.



Fig. 29.

Section of the Air-Cells.



Fig. 32 (Leidy).

Mode of branching of nerves.—
1, 2, two bundles of nerve fibres;
3, a branch of three fibres; 4,
branch of two fibres; 5, 6,
branches of single fibres; 7, de-
cussation between two nerves.

See Answer 256.

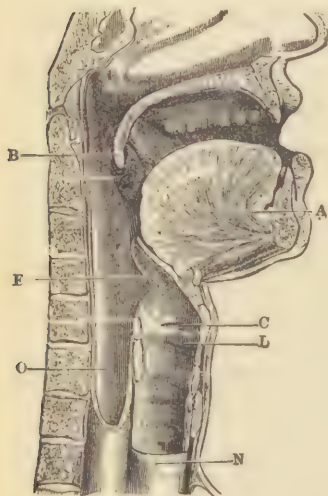


Fig. 30.

A, Tongue; B, Uvula; C, Vocal
Cord; E, Epiglottis; L, Larynx;
N, Trachea; O, Oesophagus.



Fig. 33 (Gray).

Nerve cells from spinal cord.

mation of the large bronchial tubes; and *pleurisy*, an inflammation of the pleura, or outside wrapping of the lungs. Among the young, an inflammation of the trachea takes place, known as croup.

198. As in the circulation of the blood, tight clothing will compress the blood vessels and thus cause a constriction and hinder the free respiration. The compressing of the abdomen by means of corsets, etc., results in the reduction of the air space in the abdomen.

199. (a) *Sneezing* is the forced expiration through the nostrils. (b) *Hiccoughing* is the sudden inspiration due to the sudden contraction of the diaphragm. (c) *Coughing* is a forced exhalation in which the larynx is opened wide. (d) *Whistling* is due to the puckering of the lips as to cause a vibration of the air within the mouth. (e) *Snoring* is due to the vibration of the soft palate and the tongue, the air passing partly through the mouth and partly through the nostrils.

200. Shortness of breath may be due to heart disease or to the diseased condition of the lungs.

201. Good breathing implies the presence of sufficient pure air. Good breathing is opposed to taking into the lungs the air which has just come from them or from the lungs of someone else. The amount of air in bedrooms during the night should never be less than the amount required during the day time, about 2,000 cubic feet of fresh air per person per hour. If this amount is provided per person during the sleeping hours, there would be fewer cases of colds, pneumonia, and especially consumption.

202. *Schaefer's method of artificial respiration* consists of pulling the tongue forward in order to favor the passage of the air along the base of the tongue into the windpipe and then drawing the arms away from the sides of the body and upward, so as to meet over the head, by means of which the ribs are raised (expansion of the chest) by the chest muscles running from them to the arms near the shoulder. A vacuum is thus created in the lungs, and the air rushes in; the blood is then purified by the passage of the impure gases in the blood vessels to the air, and by the giving up by the air of a portion of the oxygen to the blood. The arms are now brought down to their original posi-

tion near the sides, and the elbows made almost to meet over the "pit of the stomach." This produces the contraction of the chest walls and the expulsion of the impure air from the lungs. These two movements cause one act of respiration, and should be persisted in, without interruption, at the rate of about sixteen per minute. The tongue may be held forward by means of a handkerchief or dry cloth. This may continue for as long as an hour and thirty minutes in order to bring on normal and natural breathing.

203. That the lungs should be exercised is self-evident. This may consist of inhalation and exhalation made deliberately, with gradual and slow light beating of the chest with the hands or the fists. The chest should be thrown out and the shoulders back during the exercises.

204. The various diseases of the respiratory system should be carefully guarded against, as their results may be fatal. The mouth should be kept closed in cold weather or in the face of a wind, the air that is breathed in should be clean; that is, breathing should be, as far as possible, through the nostrils. Inflammation of the membranes of the organs of the respiratory systems should be taken in hand at once, as the various germs find ready lodgment there and multiply most rapidly. The usual and common diseases of the respiratory system are pleurisy, pneumonia, catarrh, influenza, croup, diphtheria, bronchitis, and tuberculosis. See answer 197.

205. *Adenoids* are spongy growths frequently occurring in the back of the nasal cavities of children, interfering with the circulation of the blood to the brains, and causing mouth breathing and indistinct speech. A number of the common ailments and much poor work of school children are attributed to these, and the best thing that can be done is to remove them. The symptoms of the presence of adenoids are open mouth, prominent eyeballs, nasal speech.

206. Alcohol first causes an increased warmth on the surface of the body because the capillaries are dilated and the stimulation causes more blood to flow to the surface. The lungs and the mucous membranes become affected in like manner, and respiration is increased, causing the quick heavy breathing of the alcoholic drinker. The reaction, however, soon takes place, and

the surfaces lose their heat by radiation and the respiratory organs cannot keep up their usual work, with the result that general depression occurs. The capillaries of the lungs are enlarged with this condition, and respiration cannot be normal.

207. The heat and gases resulting from smoking dry the mucous membranes and irritate the throat, nasal passages and larynx. Frequently indistinct speech, due to the chronic husky voice, is the result.

208. See answer 203.

209. One-fifth oxygen, four-fifths nitrogen, with varying proportions of carbon dioxid, vapor of water, nitric acid and organic matter.

210. (a) The plants and vegetables are the great oxygen producers. They absorb the carbon dioxid that is breathed out, and with the aid of the sun they produce oxygen in great excess of what they themselves need. The excess is the source of the oxygen for mankind.

211. The air is full of dust and germs. After a rain, these are absent for about an hour. The air over the mountains and the ocean is almost pure.

212. Decayed foods or other matter give off gases that cause bad odors and are the breeding places for germs of great harm. These odors are foul. Foul air in cellars or mines contains more carbon dioxid than the body can inhale and suffocation is the result. Foul air arising from cesspools or sewers does not contain germs, as a general rule, but it does have a suffocating and very harmful gas. In mines, carbonic acid gas forms the fateful *choke-damp*, while carburetted hydrogen is the *fire-damp*.

213. Night air is far purer than the day air because of the purification due to the settling of the dust on the surface of the earth. However, the air is considerably cooler than the day air, and the body should be kept warmer if one is to sleep in open air or to have night air pouring into the room. Sleeping in night air is one of the aids in the cure of tuberculosis.

214. *Mountain air* is purer than air nearer the surface of the earth because of the absence of germs and dust. Moreover, there is a greater amount of vegetation on the mountains than in the lowlands, comparatively, and there is consequently a greater production of free oxygen. The air on the mountains is rare, and

the lungs have to exert themselves more as a result in order to furnish a sufficient supply to the body.

Seashore air has a certain tang to it, whether because of the greater percentage of ozone in the air or because of some free elements that are found in the seaweed and other marine vegetation, is not known; but certain it is that the air is exhilarating. Hay fever and bone tuberculosis are relieved at the seashore.

215. Ventilation is the arrangement of providing for the passage out of the impure respired air and the intaking of the fresher pure air.

216. Ventilation should always be provided for, at all seasons, and in all climates. The air in a room should at no time be both dry and too hot or too cold. If the air is too cold, then cold may follow. If the air is too warm, the body becomes too warm and cold or the grip may be the result on leaving the room. The temperature in a room should be between 65 and 68. During the winter months the air should be slightly warmed when taken in, if that is possible, but it should be seen that the air in the room so taken in is not absolutely dry, as this condition may cause a drying of the mucous membranes of the nose and the throat, with consequent irritations. Cold air being heavier than warm air, the cold air that is taken in near the floor or at the bottom of the window opening should be deflected toward a heater without causing a draft. Two or three windows in a room, pulled down from the top to allow of the egress of the warmed respired air, and raised a few inches at the bottom to permit of the ingress of the fresh air, afford excellent ventilation. A slanting board close to the sill and slanting upward and inward, deflecting thereby the current of incoming air inward and upward, will prevent drafts.

217. Besides carbon dioxid, the respired or exhaled air contains ammonia gas, from the oxidation of the nitrogenous substances within the body, and considerable organic matter, giving the foul odor to respired air when confined.

Air that has been breathed out by a person contains about eighty parts nitrogen, sixteen parts of oxygen and four parts of carbon dioxid, which have displaced four parts of oxygen taken by the blood. There is also a small amount of solid matter which, when decomposing in a room that is not ventilated, causes

the odors of an unventilated room. The air that is exhaled is also warm and moist, showing that the body has lost some heat. The heat in a room that is crowded and not ventilated is caused by the heat in the respired air.

218. Breathe into a glass tube containing lime water. The lime water will become cloudier with each breathing, showing that the carbon dioxid acts upon the lime, causing the formation of carbonate of lime.

219. Proportion of carbon dioxid in 1,000 parts of air:

Country air	.4
City air	.5
Fairly ventilated school air.....	1.2-2.5
Air in court-houses, factories, etc.....	4.0-40.0
In closed bedroom.....	5.0
Aired bedroom	1.5
Occasionally breathed, causing discomfort	3.0
Occasionally breathed, distressing.....	10.0
Exhaled air	40.0
Absolutely poisonous	100.0

220. The evil effects of impure air are: dullness and drowsiness, faintness, heaviness, oppressed nervous state, all due to the impoverished condition of the blood. Certain diseases of the lungs, as consumption, or tuberculosis, asthma, etc., are the direct result of impure air breathed in almost continuously.

THE EXCRETORY SYSTEM.

221. *Wastes* are those substances that are given off by the body in its various processes as being of no further value to it. Carbonic acid gas, urine, perspiration or sweat, are some of the waste products.

222. The *kidneys* are the organs that give off the waste urine. They are two small, round organs, lying against the posterior surface of the abdominal cavity, one on either side of the spinal column, just below the diaphragm. The renal artery, coming direct from the aorta, divides into thousands of branches and branchlets, each of which ends in a very tiny ball of capillaries. These carry the urine to the inner edge of the kidney, from which organ it goes to the *pelvis* and then to the *ureter*. The ureter is

a tube connecting the kidneys with the bladder, a sac slightly larger than the fist.

See Fig. 10.

223. In the blood coming to the kidneys there is much water, mineral matter, and waste flesh, called urea. Due to the pressure of the blood, the water, salts, waste, are passed into the kidney tubes, and from there to the pelvis, ureter, and bladder. The cells of the kidney prevent any nutriment from passing through them, allowing only the harmful waste to continue on the journey. No errors are made in the selective work of the kidneys, unless they are overworked or affected by disease.

224. (a) The more water one drinks the more the kidneys excrete, and therefore, the more waste urea is passed out of the system. Water acts as a carrier and flushes the kidneys. In rheumatic troubles, in constipation, or in clogging of the lower bowels, the water has the most effective and beneficial results. A person should drink at least a quart of water daily. (b) *Bright's disease* is an inflammation of the kidneys due to the escape of some of the albumen from the blood into the urine. It is sometimes caused by alcoholic drinking.

225. The *skin* is made up of two layers, the *outer, epidermis, cuticle, or scarf-skin*, and the *inner, cutis, or true-skin*. The two layers are closely united, but in a burn, they may be seen apart. The cuticle is the thinner in most parts of the body, and has the appearance of a whitish membrane. It is tough and elastic, has no feeling, and does not bleed when cut. It is composed of minute flat cells, closely compacted, and arranged layer upon layer. This skin is pierced by a hundred or more tubes to the square inch, the tubes leading from the sweat glands. The epidermis is constantly worn out, and falls from the body in scales, these being dead cells; and in the scalp, they form the dandruff. It is constantly renovated from below, the new cells forcing the older cells to the surface. The *cutis* lies beneath the epidermis, and is its origin and support. It is very sensitive, firm, and elastic, and is freely supplied with blood-vessels and nerve-endings, these being located in the ridge-like *papillæ*. See Fig. 21.

226. The functions and uses of the skin are six in number: (a) it is a covering and protector for the external surface of the body; (b) it is an organ of sensation; (c) it is an organ of

excretion; (d) it helps to regulate the temperature of the body; (e) it is an organ of absorption; and (f) it is an accessory organ of breathing.

227. (a) As a protective covering, the skin is thick and strong on those parts of the body most subject to pressure and friction, as in the palms of the hand, the feet, etc., and thinner in the armpits, under the knees, etc., where motion or greater elasticity is required. When covered with hair, it forms an especially strong protection. (b) Being abundantly supplied with blood-vessels, and nerve-endings, it is the seat of the sensations of touch and temperature. The sensibility of the skin is greatest on the pulp of the fingers and the front of the body, and least on the back and in the middle of the limbs. The value of this sensitiveness is seen in the many different occupations.

228. (a) As an organ of excretion it is of the greatest help. During illness, where the kidneys will do little or no work, the effort is made to excrete by means of the perspiration. The wastes in perspiration are water, carbon dioxid, fatty acids, ammonia salts, etc. (b) The bodily heat is due to the activities of the various organs, making the internal general temperature of the body 98.4-5 degrees F. Loss of heat is due to contact of the body with anything cold, by radiation, and through the excretions; but the due regulation of the bodily temperature depends, in part, upon the elimination of the watery vapors by the lungs, but mainly upon the perspiratory functions of the skin. The constant evaporation through the skin tends to keep the body in equilibrium as regards the temperature.

229. (a) The skin takes up and passes through it into the lymphatics and capillaries, certain substances with which it may come into contact. Certain drugs that are injected by means of the skin, the rubbing in of oily and other medical preparations, all of these prove the efficacy of the skin as an absorbing medium. The evil effects of some of the occupations are seen in the absorption by the skin of the poisonous materials used in these occupations. (b) The skin absorbs a small quantity of oxygen, and gives out a larger amount of carbonic acid gas, doing about one-fortieth to one-fiftieth of the respiratory work.

230. Senses of touch and temperature.

231. Pressure or friction of the skin continued in for a long time results in the thickening of the epidermis. A *blister* or a

corn will be produced. A blister may also be due to the irritation of the skin by means of a mustard plaster or any other irritating substance. A corn is the result of the continued thickening of the epidermis until it reaches down and presses on the cutis.

232. There are about two million sweat glands distributed in the lowest layers of the cutis, being most profuse in the forehead, the palms of the hand, and the soles of the feet. These coiled tubes lead to the *pores* in the skin, and give forth the *perspiration*, or *sweat*, about a quart being excreted by an adult in a day under ordinary circumstances. During the warmer weather the amount of sweat excreted is greater; heat and work will also increase the amount. For the composition of sweat, see answer to 228 (a). The sweat serves to regulate the temperature of the body, affords a means of excretion accessory to the excretory work of the lungs and the kidneys.

233. The *sebaceous*, or *oil glands* are present wherever hair occurs. Each gland opens by a duct near the top of the sac inclosing the root of the hair. Its secretion is an oily fluid which keeps the hair soft, and the skin pliable. Gentle massaging, rubbing, or pinching will increase the flow from these minute glands.

234. The hair is a modified form of the cuticle. It is found, of greater or less length, on almost all parts of the skin, except the palms of the hands and the soles of the feet. The bulb, or root, of the hair is lodged in a tiny sac or follicle of the skin. The shaft is the part that grows above the skin. Its growth is in one direction, in length alone. The outer part of the hair is quite firm, while its interior is softer, and supplies the nutriment by which it grows. In health, the hair is more glossy than at times of illness. The color of the hair is due to the pigment, or coloring matter, secreted in the central portion of the hair.

235. (a) *Baldness* is due to the falling out of the hair. (b) *Dandruff* is the dry, dead cell matter, which is loosened from the skin. (c) Washing the scalp thoroughly with soap and soft water, drying it thoroughly after the washing, rubbing the scalp well with a fairly hard bristle brush to keep the blood in circulation, application of a good, reliable hair tonic in moderate amounts and not too often, all of these will tend to preserve the

hair. The advertisements that state that baldness will and can be cured are fraudulent, as no substance or method will cause the hair to grow.

236. (a) In the deeper cells of the cuticle lies a pigment, or coloring matter. It is on this that the complexion of the person depends. Its presence, in greater or less quantity, in one color, hue, or shade, causes the differences in complexion that exist among peoples and races. Freckles are due to the irregular increase of this coloring matter. The sun has a marked effect on the pigment of the skin. (b) The complexion is an index to the health of the person in a great many cases. The yellow complexion tells us that the bile flows into the blood, instead of being secreted. The pasty complexion tells us that there is an irregular condition in the stomach or some other organ. Redness in the face is a marked index of the too frequent use of alcoholic beverages. (c) Wash the skin with soap and water frequently, keep the pores of the skin open, exercise actively to cause the steady circulation of the blood, massages, etc., drinking water and lemonade and avoidance of alcoholic drinks, etc.

237. The *nails* are modifications of the epidermis, identical in formation, but peculiar in appearance and manner of growth. The nail rests in a "matrix," which is a fold of the dermis, particularly rich in papillæ, from which the nail cells are produced. When nails are destroyed, new ones will be formed if the matrix is uninjured. Nails are a support and a defence to the ends of the fingers and toes, and assist in the picking up of small objects, and, if healthy and in good condition, add comeliness to the parts to which they are attached. The health of the nails is affected by local or general diseases.

238. The main value of the *hot bath* is its cleansing property, while the *cold bath* is tonic in effect. The *hot bath* should be taken twice a week, and the body thoroughly and cleanly washed. The proper time for a hot bath is at night, just before retiring, as the heat draws away the blood from the head, and makes the brains less active and is apt to induce sleep. The bath should not be taken after a meal, as the digestive process requires all the help from the blood. The *cold bath* should be from about sixty-eight to seventy-eight degrees. The most favorable time for this cold bath is immediately after arising in the morning or

after exercise. It should not last more than a minute or two, and should be followed by a brisk rubbing down. *Sea bathing* is even more invigorating and tonic in effect, because of the immersion of the body into the salt water, and the activity required. The *sun bath* should not be indulged in too long or too often, or in the too strong rays of the summer sun.

239. The extensive use of cosmetics for the complexion is a fertile source of disease. The use of hair-dyes that contain poisonous or filthy and otherwise harmful ingredients should be avoided, as they rob the hair of its vitality. Soap and water are the best agents for the complexion and the scalp.

240. The chief use of the clothing is to maintain a regular temperature on the surface of the body, and thus, to prevent sickness. The essential requirements of clothing are lightness, proper ventilation, and warmth. These three qualities of clothing will necessarily depend upon the person, as some are warmer blooded than others, and do not require such heavy clothing; while others are cold-blooded and cannot tolerate light clothing. The question of wearing too much or too little clothing is one for the individual himself to answer. The practice of exposing the limbs and necks of children is questionable and in many cases extremely hazardous. Clothing should be changed before retiring and on awakening. The day clothes should be aired during the night, and the night clothes and bedding aired during the day. Wet clothes should, under no circumstances, be worn any longer than is absolutely necessary.

241. Clothing that is often worn requires a *texture* that will permit the air to circulate through it, or should be so arranged that air will pass beneath it. Tightly-woven and close-fitting clothing and impervious rubber outer garments do not permit the circulation of the air. *Color* in dress is no unimportant consideration, besides being a matter of taste. Dark colors, black, blue, etc., are considered the best for cold weather, while the lighter colors, white, gray, lavender, etc., are desirable in warm summer days. Care must be taken in the dyeing of the textiles, as many of the dyes contain or require for their fastening on the textiles poisonous materials.

242. *Woolens* are the best textiles as far as warmth is concerned, because they retain the heat and the moisture longer,

thereby preventing the sudden cooling of the body from rapid evaporation. Hence, flannels and merino are the best woollen garments. *Silk* is the next most suitable material, especially for undergarments. *Cotton*, and then *linen*, come next in order.

243. Of cloth of different material exposed to the sun's rays—

White Cotton received.....	100° F. of heat.
“ Linen received	98° F. of heat.
“ Flannel received	102° F. of heat.
“ Silk received	108° F. of heat.

Of shirtings of different colors so exposed—

White received	100° F.
Pale straw color received.....	102° F.
Dark yellow received.....	140° F.
Light green received.....	155° F.
Dark green received.....	168° F.
Turkish red received.....	165° F.
Light blue received.....	198° F.
Black received	208° F.

244. Alcohol enlarges the arteries and capillaries of the skin, makes the face red, and in cold weather the increased amount of heat on the surface of the body is rapidly radiated, leaving the body cool. The skin gets a rough, blotched, ruddy appearance.

THE NERVOUS SYSTEM.

245. A perfect nervous system allows the harmonious co-operation of the bodily organs and systems; a disordered nervous system causes a derangement of the various systems, and, consequently, does not permit perfect control and the proper combination of the various organs for the working toward a definite end.

246. That part of the general nervous system concerned with the animal functions is called the *cerebro-spinal*, or *central nervous system*, because it comprises the brain, the spinal cord, and the nerves emanating from it. The other, the *sympathetic nerve* system, regulates the vegetative functions. Fig. 31.

247. The brain and spinal cord are the managers and directors of the actions and deeds of the human body, that is, the willed acts and deeds. They direct the other organs as to the amount of the work to be done, and the time to do it. Fig. 31.

248. The brain is a pulpy-looking mass loosely filling the skull, the outside of which is folded and wrinkled. The two parts are the *cerebrum*, or brain proper, and the *cerebellum*, or little brain, lying just back of and beneath the cerebrum. The brain is securely fastened in the skull and protected by three membranes, the outermost one, the tough *dura mater*, the middle *arachnoid*, and the innermost tender *pia mater*. The pia mater carries the blood vessels, and dips down into all the crevices and fissures. By means of nerves, the brain is in direct communication with all parts of the body. Figs. 31, 34, 35, 36.

249. The *cerebrum* is the most important part of the brain, and is divided incompletely by longitudinal fissure into two equal parts called *hemispheres*. The exterior of these hemispheres is gray in color, consisting chiefly of nerve-cells, arranged so as to form a layer of gray matter one-fifth of an inch in thickness, and is abundantly supplied with blood-vessels. The interior of the brain, however, is composed almost wholly of white substance, or nerve-fibers. The surface of the cerebrum is divided by a considerable number of winding and irregular furrows, about an inch deep. The sections are connected at the base and with the other parts of the brain. Each hemisphere is divided into five lobes. The two other fissures are the fissure of the Sylvius, above the ear, and the fissure of Rolando, extending from the crown obliquely forward and downward. Figs. 31, 34, 35, 36.

250. The *cerebellum* is almost as large as a fist, and lies back of and above the medulla. Its surface is deepened by cuts or *sulci*. The surface of the cerebellum is composed of gray matter, and its interior chiefly white matter. It has, however, no convolutions, but is subdivided by many parallel ridges, which, sending down gray matter deeply into the white, central portion, give the latter a somewhat branched appearance. In size, this cerebellum, or "little brain," is less than one-eighth of the cerebrum. Several bands of nerve fibers connect it with the spinal cord and the other parts of the brain. The *pons Varolii* is the middle part of one of these, and appears flat on the lower side of the brain. The cerebellum is the seat of co-ordination. When it is injured co-ordinated actions cannot take place. Figs. 31, 34, 35, 36.

251. The *medulla oblongata* is a stem or bulby stem joining the



Fig. 31.

A Back View of the Brain and of the Spinal Cord and its Branches.

higher parts of the brain with the spinal cord. The medulla oblongata gives rise to all the cranial nerves, except the nerves of smell and of sight, besides conducting the sensory and motor influences. A portion of the medulla presides over the important function of respiration, and from it arises the *pneumogastric* nerve, whose branches serve both the lung and the stomach. Figs. 34, 35.

252. The outer layer of the brain is composed of the gray matter, called the *cortex*, and near the center are other masses of gray matter, while the rest of the brain is composed of white matter consisting of fibers of spherical cells.

253. When a person has once performed an action a certain path has been made on his brain surface. Certain cells have been called into play. When that is repeated, the same set of cells are called into play, and the groove or channel of cerebral energy is deepened. Finally, this groove becomes so deepened that the person, as soon as the impulse arises, cannot do otherwise than perform the same action, because the set of nerve cells is ready to send out the nerve energy. This is *habit*.

254. (a) The *neuron* is the true nerve cell, from which extend long processes called *axones*. (b) Some of the axones extend to the spinal cord and are nearly two feet in length. *Nerve fibers* is another name for these axones. (c) The nerve fibers which cross from one side of the brain to another and connect parts of the same name are called *commissures*. The *corpus callosum* and the *pons Varolii* are two of the most important. Figs. 32, 33.

255. The important spinal cord is well protected in the vertebral column, being about the thickness of the small finger, and covered by several membranes similar to those of the brain. The spinal cord is divided into two halves practically by the anterior and the posterior fissures, which divide the cord incompletely. The interior of the cord is composed of the gray matter, while the exterior is composed of the white fiber matter. The gray matter is composed of the cell bodies, from which extend to the various sections of the body long axones that aid the nerves of the various regions. Figs. 31, 39.

256. "If one lateral half of the spinal cord be cut, or injured, a very singular fact is observed. All voluntary power over the muscles of the corresponding half of the body is lost but the sen-

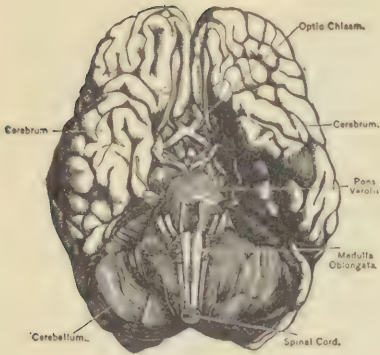


Fig. 34.

The Base of the Brain.

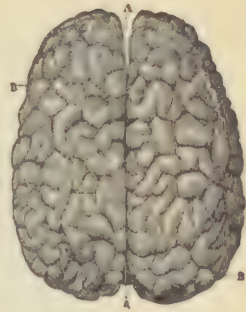


Fig. 36.

Upper Surface of the Cerebrum.
A, Longitudinal Fissure. B, The Hemispheres.

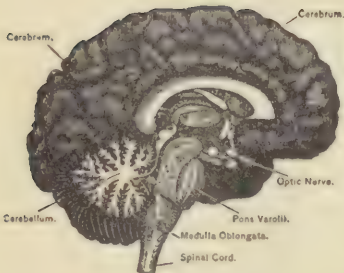


Fig. 35.

View of the Left Half of the Brain.

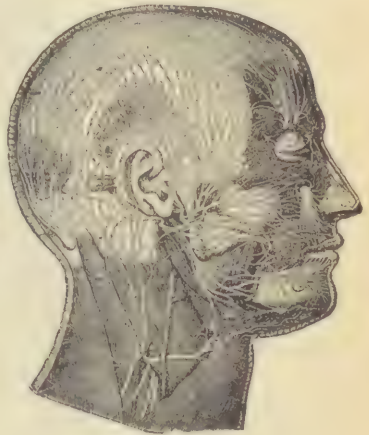


Fig. 37.

Superficial Branches of the Seventh and the Fifth Pair of Cranial Nerves.

sibility of that side remains undiminished. This result shows that the motor fibers of the cord pursue a direct course, while its sensory fibers are bent from their course. And this has been proved to be the fact; for immediately after the posterior roots—the conductors of sensory impressions—join the posterior columns, they enter the gray matter of the cord, and passing over, ascend to the brain on the opposite side. Accordingly, the sensory fibers from the right and left sides interlace each other in the gray matter; this arrangement has been termed the *decussation*, or crossing of these fibers. This condition serves to explain how a disease or injury of the cord may cause a paralysis of motion in one leg, and a loss of sensation in the other.

“The direction of the anterior, or motor columns of the cord, is downward from the brain. In the cord itself, the course of the motor fibers is for the most part a direct one; but in the medulla oblongata, or upper extremity of the cord, and therefore early in their career, these fibers cross from side to side in a mass, and not separately, as in the case of the posterior fibers just mentioned. This arrangement is termed the *decussation* of the anterior columns of the medulla.

“From this double interlacing of fibers results a cross action between the original and terminal extremity of all nerve-fibers which pass through the medulla—namely, those of all the spinal nerves. Consequently, if the right hand be hurt, the left side of the brain feels the pain; and if the left foot move, it is the right hemisphere which dictates its movement. For the same reason, when a loss of sensation and power of motion affecting the right side of the body alone is observed, the physiologist understands that the brain has been invaded by disease upon its left side. This affection is termed *hemiplegia*, or the ‘half-stroke.’ The full-stroke, which often follows the rupture of a blood-vessel in the brain, is commonly called *paralysis*.”

257. The two great classes of nerves are (a) *motor or efferent* nerves, which convey the will messages of the brain outward to the peripheral organs and cause the organs to act, and the (b) *sensory or afferent* nerves, which carry the messages and warnings or sensations to the spinal cord and the brain. Both of these nerves are often found bound together, but each performs its separate duties.



Fig. 38.

Diagram of pneumogastric nerve, with its principal branches.—1, pharyngeal branch; 2, superior laryngeal; 3, inferior laryngeal; 4, pulmonary branches; 5, stomach; 6, liver.

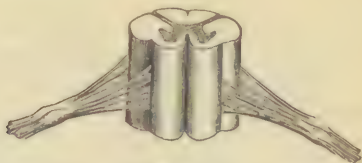


Fig. 39.

Section (front view) of Spinal Cord, with Roots of Spinal Nerves.

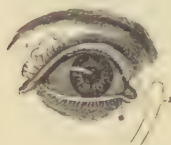


Fig. 40.

Front View of the Right Eye.

1. The Lachrymal, or tear gland, lying beneath the upper eyelid.

2. The Nasal Duct is shown by the dotted line. The * marks the orifice in the lower lid.

The central black spot is the pupil; surrounding it is the iris; and the triangular white spaces are the visible portions of the sclerotic.

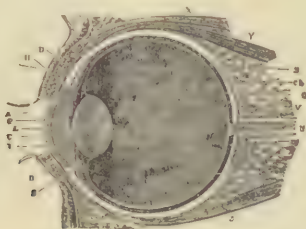


Fig. 41.

Vertical Section of the Eye.

C, The Cornea

A, The Aqueous Humor

I, The Iris

P, The Pupil

L, The Crystalline Lens

H, The Ligament of the Lens

B, The Ciliary Process

V, The Cavity containing the Vitreous Humor

S, The Sclerotic

Ch, The Choroid

R, The Retina

N, The Optic Nerve

DD, The Eyelids

X, The Levator Muscle of the Upper Lid

Y, The Upper Straight Muscle of the Eye

Z, The Lower Straight Muscle.

258. A *ganglion* is an aggregation, or group, of nerve cells. Each ganglion is, in some respects, a little brain. The spinal ganglia receive a sensory impulse and send out a motor dispatch without calling upon the brain at all. This is called reflex action.

259. The spinal cord not only conveys sensations to the brain and receives from it the motor impulses, but it also arrests certain other sensations and originates motor impulses; it reflects them into movement by its own power. This is what is called *reflex action*. This is noticed by the person only after the action or deed has been performed. For example, if the foot of a person soundly asleep be tickled or pinched, it will be quickly withdrawn from the irritation. The raising of the arm to ward off a blow is another illustration of reflex action. The reflexes are of the greatest importance to our self-protection.

260. Only after they have occurred.

261. The sympathetic nerve system consists of a double chain of ganglia on the sides of the spinal column and scattered ganglia in the head, neck, chest, and abdomen. These ganglia are connected with each other by filaments, and with the central nervous system by motor and sensitive fibers. From these ganglia numerous delicate fibers are distributed, chiefly to the alimentary canal and its appendages, the heart, blood vessels, and other organs whose actions do not depend upon the will. At various points of the system are *plexuses*, formed by the meeting of many of these fibers. The solar plexus, in the abdomen, is one of the most important. Shock or concussion of the sympathetic system causes death.

262. The sympathetic nervous system controls, for the most part, the vegetative functions, circulation, digestion, respiration, so that ordinarily we have no conscious knowledge of the workings of these important organs. Yet there may be some slight disturbances of the system because of the connection between the two nerve systems. Emotional disturbances, unpleasant odors, sounds, may have a disastrous effect on the sympathetic system.

263. These are very important and active. They protect the body by involuntary movements, regulating the so-called vegetative acts, and take the place of the volition in the control of the voluntary muscles when the attention is turned to other matters. Speech, intimately connected with the act of respiration, cough-

ing, sneezing, winking, laughing, walking, sitting, other acts of daily life, are all the results of automatized reflexes, resulting from their habitual performance. Thus the mind is released from the charge of the ordinary mechanical acts of life, so that it may devote itself to nobler faculties.

264. The function of the cerebellum is the direction of the movements of the voluntary muscles. Injury to any part of it leads to failure in executing orderly and regular acts, the person appearing to be in a state of confusion and intoxication.

265. The cerebrum is the office or seat of the mind. All the other organs are subordinate to it. It is the seat of the willing, and the nerves are the messengers of its volitions. All the highest and loftiest actions of the mind, as well as the lowest, are the result of its volitions.

266. The anterior roots of the spinal cord are concerned in the production of motion, while the posterior roots are concerned with sensation; in other words, the anterior are efferent, while the posterior are afferent.

267. Some nerve-fibers convey power of motion, others of general sensation, others special sensations, and still others have the power of causing secretion; but with all this difference of function, there is no difference of structure or composition.

268. The function of the nerve centers is to receive nerve impulses, to originate and impart nerve impulses, and to transmit these impulses from one center to another.

269. There are thirty-one pairs of spinal nerves, consisting of both sensory and motor nerves. Each of these nerves is connected to the spinal cord by a dorsal root and a front ventral root. The dorsal root is the means of supplying the feeling, while the ventral root conveys the motion.

270. The *cranial nerves* originate in the medulla oblongata, are twelve pairs in number and go to the various parts of the cranium. These nerves are round cords of glistening white appearance, and lie so well protected from injury. They are: (a) *The olfactory nerves* (sense of smell), *the optic nerves* (sense of sight), *the oculomotorius* (move the eyeballs), *the patheticus* (controls the action of the superior oblique muscle of the eye), *the trigeminus* (great sensitive nerve of the face), *the abducens* (controls the external straight muscle of the eyeball),

the facial nerves (motor nerves for superficial or expression muscles of the face), the auditory nerves (to the internal ear only), the *glossopharyngeal* (control sense of taste and the act of deglutition), the *pneumogastric* (go to the pharynx, œsophagus, stomach, liver, intestines, the larynx, trachea, lungs, and heart; control respiration and digestion), the *spinal accessory* nerves (supply control over the vocal cords, muscles of neck and the chest), and the *hypoglossal* nerves (control the motions of the tongue).

271. "A nervous fiber which ends in the skin forms, as far as its union with the brain or cord is concerned, one long, fine, unbroken thread. The fibers, thus ending in the skin, very soon join to form small branches, and finally in thick nerve trunks, but in no case do two nerve fibers coalesce so as to lose their identity. Every part of the skin has its own separate connections with the center of the nervous systems, which unite there just as telegraph wires unite at a terminus. The brain is the terminus of these lines of nerves, and, as it were, receives and explains the messages sent to it. It distinguishes very clearly by what particular fiber such a message has come, and just as the clerk in a telegraph office, where a great many wires meet from all sides, knows by experience from what direction each wire brings its message, so the brain also knows by experience what part of the skin is involved when a sensation reaches it along a certain nerve fiber. It is probable that the brain, by its imaginative faculty, has formed a complete picture of the surface of the body—a kind of chart slowly made, and always being more highly perfected, by means of which, with each impression from without, there arises in the brain a picture of the spot upon the skin where the irritation has taken place. Now, if an irritation were to pass from one nerve fiber to another, it is very plain, the brain could not tell the place from which it came, and could not localize impressions received from the world about us."

272. (a) *Paralysis* is the inability of a portion or region of the body to perform action due to injury to the cell bodies or the fibers. (b) *Apoplexy* is quick paralysis, usually due to the bursting of a blood vessel in the brain, or the formation of a blood clot.

273. By observation on diseased persons, by observations on

diseased portions of the brain, by experimentation on persons and on animals.

274. The brain is smaller in women than in men, because of the differences in the size of the bodies. The average weight of the male brain is fifty ounces, while that of the female averages 44 ounces. The good mind, the active, big brain is usually big. However, the intellect does not depend so much upon the size of the brain as upon the development of the brain, that is by the number of convolutions, the gray matter surface.

275. Just as a muscle or any organ becomes atrophied from non-use, and becomes stronger and has greater development with proper use, so with the brain. Thinking causes the blood to bring a greater amount of nourishment to the brain, because the brain then requires more blood. The more the brain is properly exercised, the greater is its development, and the stronger does it become, and the better fitted to continue with deeper thinking.

276. The person that does considerable thinking, that consumes a great amount of nerve energy in his work requires the proper amount of sleep. The rest period allows the nervous system to recuperate its nervous energy. Adults should make it a point to sleep at least eight hours a day, the time of retirement being regular, and the same each night. One should not take drugs without the advice and consent of physicians.

277. It frequently happens that on retiring a person thinks of a problem the solution of which is important to him. During the sleep the mind continues working without his consciousness and, on awakening, the person finds that the problem has been solved. That is, the cerebrum performs its work during his period of unconsciousness. This is called unconscious cerebration.

278. Some of the evil effects of the smoking of tobacco on the nervous system are: nausea, vomiting, vertigo, weakness, and general debility.

279. The habitual use of alcoholic drinks makes marked changes in the structure of the brain. It becomes harder and tougher than is natural, its cell elements waste away, a watery fluid fills the cavities caused by the shrinking of the substance, and the blood vessels show a weakened condition. As to the effects on the mind, the perceptions are bewildered, there is sleeplessness, loss of memory, weakened judgment and reasoning powers, and

a benumbed and clouded moral sense. The most important ill effect is the loss of self-control, and, finally, insanity may be the end.

280. The use of narcotics, such as opium, chloral hydrate, chloroform, or any other habit breeding drug is so generally harmful and disastrous in its effects that laws have been passed by the various State legislatures forbidding their sale without a doctor's prescription. The weakening of the system in general, the destruction of the fine nervous sensibilities, the craving for drugs and their habitual use, the gradual but certain self-poisoning are the results.

THE SENSES AND THEIR ORGANS.

281. The *internal* or *general* senses which tell the individual of the condition of his body, as those of hunger, thirst, etc. The *special* or *external* senses, which result from sensations of the external, or special organs, are those of hearing, taste, sight, smelling, pain, temperature, touch.

282. Sight, the eyes; hearing, the ears; touch, the skin; smell, the nose; taste, the taste buds; pain, the skin; temperature, the skin.

283. The senses of the skin, often called touch, are those of pain, temperature, and pressure, and result from the stimulation of certain nerves ending in the skin. They are often called the cutaneous senses.

284. (a) The sense of taste is located in the *taste buds* found in the mucous membranes of the tongue, soft palate, and other regions of the throat. These taste buds are connected by means of nerve fiber with the brain. (b) The sense of taste is aroused only when the stimulation comes from a liquid, that is when the substance is in the form of a liquid. Solids must be chewed so that the saliva will convert or help convert the food into liquid form.

285. The sense of smell resides in the mucous membrane lining the upper nasal cavity. The organs consist of hundreds of columnar cells on each of which are six or eight hairlike processes. Every object that is smelt gives off tiny particles. The impingement of these particles on these hairlike processes causes the stimulation to be conveyed by the olfactory nerves to the brain, which, interpreted, gives us the sense of smell. The closing of

the nostrils due to cold or other means will result in the temporary absence of smell. Odors to be recognized, must be presented in gaseous or vaporous forms to the mucous membrane in the nostrils.

286. (a) The eye is located in the front of the head or skull, in the orbital cavities. (b) The eyeball is held in place by means of four straight, *recti*, and two oblique muscles, the contraction of any one of which causes the eyeball to move. A contraction of the inner one causes the eyeball to be moved toward the nose, the movement of the outer one giving the opposite motion. The remaining four muscles give to it the other movements from top to bottom, side to side, etc.

287. See Fig. 41.

288. The eyebrows prevent the perspiration from running into the eyeball; the eyelashes prevent the dust from getting into the eyeball; the deep setting of the eyeballs and the overshadowing of the orbital bones are protection against the too strong rays of the light, against heavy blows, etc.

289. The wall of the eyeball is composed of three coats, the outer or tough *sclerotic* coat, the middle or *choroid* coat, and the third inner coat, or *retina*. The *cornea* is the front portion of the *sclerotic* coat, the *iris* is the continuation of the *choroid* coat.

290. (a) The retina is a very thin coat, as thin as tissue paper, very tender and pinkish white in color. It is composed of connective tissue and nerve matter, and is the outspreading of the delicate optic nerve. (b) The point of entrance of the optic nerve is insensible to light, and is therefore called the "*blind spot*," while from one-twelfth to one-eighth of an inch outwardly from this point in each eye is an oval spot (c) called the "*yellow spot*," or *fovea*, which is the most sensitive part of the retina. This *spot* is directly in the line of distinct vision.

291. There are three *humors* or transparent media. The interior of the eyeball is divided into two parts or chambers by the most solid of the humors, the *crystalline lens*. The forward part, or anterior chamber between the lens and the cornea, contains the watery *aqueous* humor, while the jellylike *vitreous* humor fills the posterior chamber of the eyeball.

292. *Light* is the result of the rapid and numerous vibrations of the substance called ether, in waves. These waves give the various colors according to the rapidity and number of vibrations of ether aroused by the sun or any other natural or artificial luminous body make the impressions on the retina, which are conveyed by the fibers to the optic nerve, which conveys the sensation to the brain, where it is interpreted. Dark or non-luminous objects are seen only when they are able to reflect from many or all points on the exterior numerous rays of light which impinge on the retina.

293. Light travels in straight lines that can be deflected out of their course by means of curved lenses. A double concave or double convex lens, that is the same curvature on each side of the glass or other crystalline object, will cause the rays of light to become so deflected that they will meet in a point, called the focal point, or focus. This is what happens when the straight rays of light from each point on an object seen by the eye, enter the eye. They are converged by means of the crystalline lens and the vitreous humor, and made to meet all in the focus, the fovea, or point of acute vision on the retina. Fig. 42.

294. (a) *Myopia*, or *nearsightedness*, is due to the fact that the rays of light are brought to a focus at a point nearer than the retina. Sometimes the eye is longer than normal from before backward, sometimes the lens or cornea is too convex. It may be remedied by wearing double concave glasses. (b) *Hypermetropia*, or *farsightedness*, is exceedingly common among those over 45 years of age. It may be a result of the eye being shorter than normal from before backward, or the outer surface of the cornea or lens may be too straight. Convex glasses will help remedy this defect. (c) *Astigmatism* occurs when the eyes do not see all lines, or parts, of the object in the same plane, and the lines or parts become slightly blurred. It is due to the unequal curvature of the cornea or lenses. It can be remedied only by an optician, who must test the eyes in order to prescribe glasses of the correct curvature. (Fig. 43.) (d) An eye perfectly formed, *i. e.*, one in which the rays of light are made to converge to a focus directly upon the retina, is called an *emmetropic* eye.

295. See answer 294.

296. The eyes should always be kept clean and clear; they

should be washed frequently in plain cold water, or in a boracic acid solution, even though they are in good condition; young children, and even older people, should never read books that are printed in type smaller than 10 point Roman; the books or paper should be held at a distance of 12 inches from the eyes; fine print should be avoided; the light should always come from behind the left shoulder, never from in front; people should be wary of reading in rapidly moving vehicles; never read in a strong sunlight; always rest the eyes after a period of reading. When anything is wrong with the eyes, do not go to a quack, but go to a registered optician or oculist.

297. (a) *Color blindness* is the inability of the person to distinguish colors, particularly the colors red and green. Its cause is unknown, and it, therefore, cannot be cured. It may be due to the inability of the eye to absorb or allow to pass through the immense number of rapid ethereal waves in the colors red and green. (b) It consists in providing a large pile of worsteds of different colors, and requiring the person examined to select the skeins which resemble the sample shown by the examiners. This method is simple, rapid, and scientific, and requires no naming of colors, which is a frequent source of fallacy and confusion. Even the normal-eyed are often at variance about color nomenclature. By this method a hundred persons may be accurately examined in an hour, and without error.

298. (a) *Cataract* of the eyes is due to the crystalline lens becoming opaque, and unless taken in hand quickly, it may result in total blindness. The doctor should be the only one to prescribe in a case of this kind. (b) *Trachoma* is an imported foreign disease of the eyes, infectious in nature, and due to dirt. It is also called *conjunctivitis*, because it inflames the conjunctiva, and also as *pink eyes*. Persons afflicted with this disease should be placed under the charge of physicians, and should be compelled to use individual towels; these should not be washed with the towels of other persons. If neglected blindness may result.

299. Lay your finger on the cheek, and draw the lower lid gently down, while the person looks as much upward as possible, and you will see about the whole extent of the lower portion of the conjunctiva. Thus, if any foreign substance is there, it will be readily detected, and easily wiped away with a folded soft

rag or handkerchief. Both lids have a piece of cartilage in them to stiffen them, like pasteboard, and keep them fitting close to the eyeball. The upper portion of this conjunctival sac can only be seen by turning over the upper lid. The way to do this is to let the person look down with the eyes closed. Taking hold of the lashes with one hand, and applying a pencil, or some small, round, smooth object, over the lid above the globe, lift the lashes out and up, warning the person to still keep looking down. The lid will suddenly turn over with a little spring from the bending of the cartilage. In this way nearly the whole of the conjunctival sac will be exposed, and any foreign body wiped away, as above described. But suppose no friend or oculist is by us to do this. The next best thing is to take hold of the lashes of the upper lid, and draw it forward and downward over the lower one, blowing the nose violently with the other hand at the same time.

If the foreign substance is on the cornea, take a strip of paper not stiffer than ordinary writing-paper, about a quarter of an inch wide, and roll it up as if you were going to make a candle-lighter. Look at the lower end, and you will see it comes to a point. With this point now you may safely attempt to remove any foreign substance from the cornea. The tears which will flow soften the paper, and prevent injury to the delicate covering membrane of the cornea.

300. Light travels in straight lines at the rate of 186,000 miles per second. Each of these straight lines is a ray. Substances which permit the light to pass through them are transparent, while objects which absorb the light or reflect it without allowing any to pass through, are called opaque.

301. They dull the senses and make changes in the sense organs themselves. They often injure the ears by inflaming the throat; they also affect the sight by causing a partial paralysis of the optic nerve, or an inflammation of the eyes and the lining of the lids.

302. See Fig. 44. Certain letters of certain size are selected, these letters being clearly seen by the normal eye at the distance indicated by the figures over the letters.

303. (a) The ears. (b) The *external*, the *middle*, and the *internal* ears. (c) The *internal* ear, because it contains the sacs



Fig. 42.
The Retinal Image.

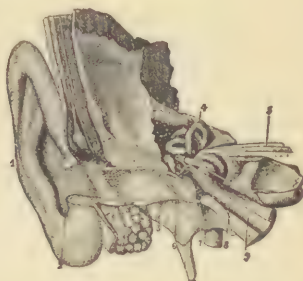


Fig. 45.

The Organs of Hearing.

- 1, auricle; 2, opening of ear, showing orifices of sebaceous glands; 3, external auditory canal; 4, semi-circular canals; 5, auditory nerve, with facial nerve; 6, membrana tympani, with the elastic fibrous membrane which forms its border; 7, tympanic cavity; 8, tensor muscle of the tympanum, the tendon being attached to the upper portion of the handle of the malleus; 9, upper portion of Eustachian tube.

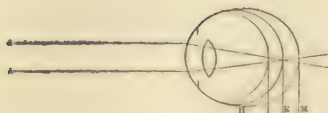


Fig. 43.

A, parallel rays of light; E, emmetropic or normal eye, rays focussing at proper point; H, long-sighted eye; M, short-sighted eye.

Dr. Snelling's Test Types.—In order that readers may ascertain whether they have normal vision, a (partial) list of Professor Snelling's test types is subjoined. The figures over the letters indicate the number of feet at which the letters should be distinctly legible.

1 ft. 8¼ in.
WELAKOTEN
2 ft. 6 in.
ULHOEDTSFG
3 ft. 3¼ in.
FOECHSUTDL
4 ft. 6 in.
ECLSTUFDOH
5 ft. 1¼ in.
SLFDCEUHTO
7 ft.
DFSEOLUHCT
9 ft.
TCHDFSEULO

Fig. 44.



Fig. 46.

Eustachian Tube, Showing the Internal Mechanism of the Ear (greatly enlarged).

that contain the terminals of the nerves of hearing. Figs. 45, 46.

304. (a) The *external* ear is composed of the pinna, or lobe, and the inch long auditory canal, extending inward. Across the inner end of this canal is the *tympanic membrane*. (b) The cavity of the middle ear, or *tympanum*, or *ear drum*, contains air, which may pass in and out through the *Eustachian* tube leading to the throat. The three bones, the *malleus*, or hammer, the *incus*, or anvil, and the *stapes*, or stirrup, form a chain stretching from the tympanic membrane to another membrane closing an oval opening into the internal ear. (c) The *internal* ear, the *labyrinth*, consists of irregular cavities in the temporal bone containing membranous sacs in which terminate the nerve endings. The three parts of the internal ear are the *vestibule*, the *cochlea*, and the three *semicircular* canals. The bony cavities are filled with a lymphatic fluid. The semicircular canals have nothing at all to do with the hearing, but they enable the body to maintain a balance and know its position, even with the eyes shut. The *cochlea* is a coiled tube in which is located the sense organ of hearing. Figs. 45, 46.

305. The moving of an object, the striking of a hard object, the shooting of a gun, disturbs the air and causes it to move in waves. The movements of these waves of air cause the vibrations of particles of air which strike against the tympanum and the carrying of these vibrations by means of the chain of the three bones to the lymph of the inner ear. The waves in the lymph beat on the delicate part of the cochlea, and are conveyed through the hairlike processes to the auditory nerve, by which the stimulus or sensation is conveyed to the brain and the sound is interpreted.

306. The ear should always be kept clean and clear. The waxy secretion for the purpose of keeping out insects and dirt may become too large, and should then be washed out, rather than removed by means of a hairpin, toothpick, or any other aid which may cause irreparable injury to the tympanic membrane. Hard objects such as pencils, sticks, etc., should for the same reason never be put into the ear. Avoid loud noises and extreme heat or cold. The ears of children should never be boxed. See 307.

307. *Deafness* is the result of the inability of the cochlea of the

inner ear to transmit to the brains the sounds which may be gathered by the pinna and the auditory canal, and the consequent inability of the brains to distinguish and interpret the sounds. It may result from a frequency of too loud sounds, from diseases of the ear, from a ruptured or torn membrane in the tympanum, from a cold in the head (temporary deafness), from inflammations, chronic or temporary, from a box on the ear, etc.

308. The best known and recognized test for deafness is by the use of a watch. Place a ticking watch at varying distances, where it cannot be seen by the persons taking the tests. Ask them to tell when they hear the ticking loudest and when it is lowest and least distinct.

DISEASES.

309. (a) *Stimulants* are those agents which increase or intensify the forces of the systems, particularly of the nervous system. (b) *Narcotics* are those agents which paralyze or depress the forces of the body. (c) A *poison* is any substance which taken into the system, by inhalation or otherwise, tends to destroy the vital force. The effects of stimulation and narcoticism may be produced by the same substance. The small quantity will usually exhilarate, while, if taken in larger quantities and with great frequency it will have the effect of a narcotic. If a narcotic is taken in very large quantity or with too great frequency, the narcotic becomes a poison.

310. Opium, laudanum, morphine, codeine, coca, cocaine, chloroform, ether, and extracts from weeds or other plants.

311. *Opium* is one of the most valuable drugs when in the hands of a physician, but one of the greatest curses when used by anyone else. It is one of the most seductive and dangerous of habit-breeding drugs. It is derived from the poppy flower, grown principally in India, Persia, and Turkey, and is bitter and disagreeable to the taste. It is either chewed or smoked in a pipe. Its tincture is known as *laudanum*. The first effect is a pleasurable, comfortable exhilaration of the system and is then followed by a period of stupor and depression. Sleep comes on with the most extravagant of dreams. On awakening the body is weak, the head aches, and the victim is nervous, irritable, and not fit for any mental activity. Its use is one of the

most despicable habits, and the most difficult to break away from. Each subsequent dose must be increased to produce the desired effect. With the continual use, the system is thoroughly undermined, and the habitué is a total wreck, physically, mentally, and morally.

312. *Morphine* is an extract of opium, in concentrated form. Its action is more powerful and much quicker. It is usually injected by means of the hypodermic syringe. Its use is just as vicious as the use of the opium, except when on prescription of a reputable physician.

313. *Coca*, with its derivative, *cocaine*,—not to be confounded with the cocoa from which chocolate and cocoa are derived—possesses high narcotic qualities. It is derived from the leaves of a bush six or eight feet in height, from the leaves of which a tea is made. Its effects are not so serious as the opiates, but the use inculcates a habit that is particularly vicious.

314. The use of *chloroform* and *ether* should be confined to the operating room or surgery. These narcotics or *anaesthetics* should not be found in the possession of the layman. Their discovery marked a wonderful advance in modern surgery, for they enable the surgeon to operate on his patient without any fear of interruption through movement, or otherwise. The patient inhales the liquid vapors and then passes into a sound sleep, the effects of which pass off in a short time after the operation has been performed. But there is a growing tendency among certain classes of people to use these for the deadening of every slight ache or pain, and this induces a habit that is vicious.

315. (a) *Bacteria* are the smallest one-celled plants. They are also called (b) *microbes*, and (c) *germs*. Minute one-celled animals, invisible to the naked eye, are also called microbes and germs. (d) The *mold* is much larger, usually in threads, and does not divide in the middle to produce new plants. They vary in shape, being spiral, round, oval, rodlike, and likewise vary in size from 1/10000 of an inch to about 1/1000 of an inch in length. They exist solely on organic matter, which they help to destroy while getting their nourishment from it. The *parasites* feed on living organic matter, while the *saprophytes* live on dead organic matter. The action of the latter results in *decomposition*, *putrefaction*, or *fermentation*, while the former's activities result

in *disease*. The activities of the saprophytes is, in the main, beneficial, since the chemical compounds resulting from their work may enter into the composition of vegetable food.

316. The three general forms in the more than one thousand kinds of bacteria now known, are (a) *cocci*, the spherical bacteria, (b) *bacilli*, rodlike bacteria, and (c) *spirilla*, or curved bacteria. The bacilli are the commonest form, the spirilla, the largest.

317. The favorable elements tending to produce bacteria are warmth, moisture, and food. The method of growth and development is to lengthen out slightly, and then to divide into two equal parts. The germs can divide so rapidly that in one day millions may be produced. Some of them can live for months in a dry state.

318. Not all bacteria are injurious. Many of them are valuable in the conversion of one food into another. The souring of cream for churning, the flavoring of cheeses, the fertilizing of the soil, the making of vinegars, are the result of the work of microbes or bacteria. This process is called fermentation. Bacteria likewise cause the decay of animal and vegetable matters necessary before the decayed matter can form a part of the soil.

319. To prevent foods from spoiling or decaying they should either be put into a cold place or refrigerator, or should be boiled to overflowing and then covered with a substance like paraffine that will keep out the air. Substances or foods that have been canned should be taken out of their containers immediately on being opened in order to prevent ptomaine poisoning.

320. *Infectious diseases*, or *diseases* caused by germs, are the result of bacteria which make their way into the body and thrive unless they are driven out of the body, or destroyed by the white blood cells or the tissues of the body. Many of the bacteria are breathed in, others are taken into the system through food; many find lodgment in the body when it is weakened as a result of excesses. A break in the skin may permit bacteria to find lodgment. The microbes injure the body in two ways: they consume the living tissue, and they generate and give off poisons.

321. Bacteria are the sole cause of *disease*. They thrive on living organic matter, and increase rapidly in number, and there-

by cause the more rapid deterioration of the living organism on which they feed.

322. (a) *Infectious* diseases are those that are caused by germs or microbes. (b) *Contagious* diseases are infectious diseases contracted through the breathing in of the myriads of germs floating in the air in the vicinity of persons afflicted with these diseases.

323. Louis Pasteur, who in 1876, made sure of the fact that each infectious disease is caused by a separate and distinct germ.

324. Non-contagious:

Contagious:

Appendicitis
Blood Poisoning,
Dysentery
Hydrophobia,
Lockjaw,
Malaria,
Peritonitis,
Sleeping Sickness,
Trichinosis,
Yellow Fever.

Bubonic Plague,
Chicken Pox,
Cholera,
Diphtheria,
Grippe, Influenza,
Infantile Paralysis,
Leprosy,
Measles,
Mumps,
Pneumonia,
Scarlet Fever,
Smallpox,
Tuberculosis, Consumption
Typhoid Fever,
Typhus Fever,
Whooping Cough.

325. Time of Development and Duration of Infection.

Name of Disease.	Period of Incubation	Eruption Appears.	Duration of Infection.
SMALL-POX. ..	12-14 days.	2-3 day on face	4-8 weeks or till scabs dis- appear.
CHICKEN-POX	7-14 days.	1-4 day	3-4 weeks or till scabs dis- appear.

Name of Disease	Period of Incubation	Eruption Appears	Duration of Infection
MEASLES.	10-14 days. Av'ge 14 days.	On forehead on 4th day of fever.	From 3 days before eruption till scurviness is gone.
SCARLATINA. .	1-7 days	On trunk 2d day of fever.	Till scurf is gone and throat well.
DIPHThERIA . MEMBRANOUS CROUP.	2-10 days. Av'ge 2-5 days.	No eruption.	From beginning till 3 weeks after throat is well.
WHOOPING COUGH	2-10 days. Av'ge 7 days.	No eruption.	Till the "whoop" is gone.
MUMPS.	15 days.	No eruption.	24 hours before the swelling and for 30 days after.
ENTERIC (TYPHOID) FEVER.	1-28 days. Av'ge 12 days.	If any, spots on abdomen 5-8 day of fever	From beginning of disease till fever disappears and diarrhoea stops
TYPHUS FEVER.	1-28 days.	5-8 day of fever	From beginning and while fever lasts.
ERYSIPELAS.	4-7 days. Av'ge 4th day.		From beginning of redness till skin is clear.

The "period of incubation" is the time from exposure to disease to the appearance of its symptoms. The "duration of infection" is the time during which the disease is liable to be communicated to others.

326. Milk is one of the most valuable and important of foods. It is the most perfect food, particularly for children. It is, therefore, necessary that the milk supply be protected. If the milk is adulterated too much, if the milk is from cows that live on dirt and filth, if the food of the cows is unwholesome, if the dairies are in an unsanitary condition, then it is only too evident that the milk will be contaminated and illnesses of the most virulent types will follow. Cholera infantum and other intestinal and diarrhoeal diseases will result, with the usual fatal effects.

327. The evil effects of alcoholism are so well known that they need barely be mentioned. Its effects on the various systems and organs of the body result in a decay in the tissue, in the functioning of the organs, in a general breakdown of the body. The body loses its vitality and is thus rendered incapable of fighting against the inhaled germs, until it finally succumbs to the ravages of the disease. Diseases of the liver, kidneys, blood vessels, heart, and nervous system result from the too frequent indulgence in beer, whiskey, or other alcoholic drink. The offspring of habitual drinkers of alcoholic beverages have weakened powers of resistance to bacteria disease.

328. *Prophylaxis* is the prevention of disease.

329. The three general methods of preventing infectious diseases are: (a) the destruction of the cause of the diseases; (b) the prevention of the spread of the disease germs; and (c) the developing in the body of some substance powerful enough to resist the attacks and ravages of the disease germs.

330. If the causes of the diseases are removed or destroyed, then no diseases can follow. It is only a matter of about thirty years since the importance of the destruction of the causes of diseases became a matter of importance to the various health boards. With the aid of the national and state boards of health, and of the various departments that have in charge the removal of garbage, sewage, etc., with the powerful aid of the newspapers and magazines, the number of cases of diseases has been con-

siderably reduced due to the prophylactic steps taken to destroy the causes of infectious diseases.

331. (a) A *disinfectant* is a substance which prevents infection, that is, a substance which destroys germs, bacteria, or microbes, micro-organisms. (b) An *antiseptic* is a substance which prevents or checks decomposition or putrefaction, that is, a substance which prevents the multiplication of micro-organisms. (c) A *germicide* is a substance which kills or destroys germs. (d) A *bactericide* is a substance which kills or destroys bacteria. (e) A *fungicide* is a substance which destroys fungi or fungus growths, parasitic growths. (f) A *deodorizer* is a substance which by its own powerful odor, destroys foul, bad, or unhealthful odors. (g) *Vaccination* is the inoculation with modified virus—the agent for communicating an infectious disease—to produce a mild form of it and so prevent a virulent attack; specifically and originally, inoculation with cowpox as a preventive of smallpox.

332. Sunlight and fresh air are the great natural disinfectants. The decay and filth of the dark, damp cellar, are rendered harmless when brought to the light and air.

Thorough cleansing and proper disinfection of refuse are matters of great importance. But where infectious matter has accumulated, or when disease is in the neighborhood, rapid and thorough action is necessary.

The most thorough disinfectant is fire. Fire destroys both the infection and the infected material.

Boiling water and steam under pressure are both thorough and effective disinfectants.

Milk of lime is a cheap and useful disinfectant where applicable. It is made as follows: Take best quicklime in lumps, put in a pail, pour on one-third as much of water, cover closely and let stand until it is a fine powder or creamy fluid; one part of this to three of water will make a saturated solution. Add water in that proportion to the mixture, stir well and then pour on half tea cup of kerosene, which will protect it from the air and preserve its strength. Use the clear solution as needed, and the semi-solid matter can be made into whitewash, or thrown into privy, cess-pool or garbage barrel.

Soap, especially soft soap, with hot water, is a cheap and very

ready disinfectant, useful in cleaning floors, furniture, etc. Sulphur fumigation is the only practical method of disinfecting a room and its contents.

333. Hospitals and sanatoria have been established at private and public cost to aid the ill. Cases of contagious diseases are, in most instances, quarantined. The hospitals and reception places have large airy rooms absolutely clean with every modern aid for the cure of disease at hand. Unnecessary furnishings, etc., are removed, and only the doctor and the nurses are allowed near the patients.

334. Immigrants are examined carefully so as to prevent the introduction of foreign diseases. Cities and municipalities are spending millions in order to remove garbage, and the latest and most modern methods of sewage disposal have been adopted. A steady and sufficient supply of pure water is insured for all large cities at the cost of millions of dollars. Propaganda have been carried on to educate the masses.

335. With the co-operation of the various agencies that have the disposal of garbage and sewage in charge the health departments have reduced enormously the number of cases of disease. The officials have made sure that cellars and other places where diseases are bred, are kept clean. They have had laws passed to make sure that the sewage, etc., is disposed of in places where there is little or no danger of infection. They have caused the latest methods of incineration of garbage and sewage to be utilized.

336. The health board is found in every community. It is usually composed of professional people, people that have made hygiene the subject of study. It is the duty of the health board to see that the garbage is disposed of without danger to the community, either through burning or dumping, to see that food is not adulterated, to prevent the sale of unhealthful foods and to assure a plentiful supply of pure water, to make sure that there are sufficient hospitals.

337. These diseases are spread by means of minute bodies called germs, passing from person to person directly; or by means of discharges, called secretions or excretions.

Particles given off from the body of a diseased person may be passed from infected persons to furniture and clothing, or find

their way out into water, food and air, and may be introduced into the system by breathing, eating and drinking or through the skin.

As certain parts of the body are the breeding places of these contagious germs discharges from these parts give them off in greatest amount.

SMALL-POX.—From the pustules: the contagion is very diffusive and continues for a long time in the scab of the pustules.

SCARLET FEVER.—From the mouth, from the saliva, breath, throat, nose, and the skin.

DIPHTHERIA.—From discharges from the mouth, throat and nose. The spittle, wet or dry, is very dangerous, as particles of the membrane may be carried and impart the disease at great distances.

MEASLES.—From the mouth, throat, nose and skin. Very communicable from the breath when laden with infective particles expelled in coughing.

WHOOPIING COUGH.—From the sputa or spittle, infectious particles in the phlegm are expelled by coughing, and carried through the air.

TYPHOID FEVER.—Discharges from the bowels, and other secretions or excretions of the patient. Water, milk and food absorb and convey these discharges.

CONSUMPTION.—By means of the spittle, which is readily conveyable when dried.

TYPHUS FEVER.—Conveyable directly through breath and eruption.

YELLOW FEVER.—Conveyable through clothing, utensils, etc.

* **CHOLERA.**—From discharges from the bowels or stomach.

SORE THROAT.—Several form of sore throat are conveyed by contact and inhalation of the breath.

MUMPS.—Conveyable at short distances through spittle.

SKIN DISEASES.—Many forms are conveyed through contact of towels, combs and brushes, etc.

SORE EYES.—From discharges conveyed through towels, etc.

PNEUMONIA.—This disease is said to be conveyable through the spittle.

338. (a) *Toxins and ptomaines* are the poisons that result from the activities of the parasites on the human organisms, and it is

to these that diseases are attributed. (b) *Antitoxins* are the products resulting in the blood from the activities of the parasites which have the effect of making the blood and tissues immune from the diseases of these parasites.

339. By far the most destructive of infectious diseases is tuberculosis or consumption. It is the disease caused by the tubercle bacillus, which enters through the respiratory tract and finds lodgment generally in the lungs, sometimes in the throat, and at other times in the tissues of bones. The germs may lie in the body for many years without propagating. The sputum of the consumptive contains many millions of these germs, and may be spread by any means. Often the tubercle bacilli are introduced into the body in the milk from the tuberculous cattle. Tuberculosis may be cured. Plenty of dry fresh air, sunshine, good wholesome food, rest, no worry, are the main items. It may take time, but many consumptives have been permanently cured.

340. *Typhoid fever* is another of those virulent diseases that can and should be prevented. The germs enter by means of either polluted water or food. It generally results from the introduction of the typhoid fever germ by means of the water that has absorbed the filth and dirt from or near the lavatories, waste piles, etc. Once it has found lodgment in a community, an epidemic may follow, the results of which may be serious. Care should be taken to wash and clean thoroughly such food as are found to flourish near places reached by human excreta, as raw oysters, celery, lettuce, etc.

341. The person should be placed flat on his back, with the head, neck, and shoulders slightly raised. The limbs should be straightened out so that the heart may act with as little disadvantage as possible and with the greatest freedom. Everything that is likely to impede circulation, as the collar, clothing, should be removed or loosened. A sip of cold water, brandy, or aromatic spirits of ammonia, should be administered in order to secure a reaction. The patient should have plenty of breathing space and the air should be set in motion. A doctor should be sent for at once.

342. The term shock is applied to a more or less severe condition of nervous prostration due to some injury, accident, or fright. The entire body is generally affected, and may, or may

not, be accompanied by loss of consciousness. The lighter forms of shock generally pass away without serious results, but the more serious cases may result in death though no evidence of injury shows itself. Different persons are affected in different ways. A person suffering from shock will usually be found to be completely prostrated, unable to stand, his body limp, face pale and anxious, with a heavy and cold perspiration, feeble respiration, almost imperceptible pulse, with or without loss of consciousness.

343. The great source of danger from shock is the cessation of heart action, hence, everything should be done before medical aid arrives to promote its normal action. The sufferer should be placed on his back, with the head low, the clothing loosened, and a stimulant in the form of hot water, brandy, or whiskey be given in small doses at intervals of fifteen minutes, the body surrounded by hot applications or hot water bottles, to insure warm perspiration, and the patient, above all, be kept quiet.

344. To a loss or deficiency of blood in the brain.

345. The person affected should be placed flat on his back with the head low to insure the flow of blood to the brain; the clothing loosened about the neck or the chest, fresh air be induced by the opening of a window, and the face sprinkled with cold water. A stimulant of a few drops of brandy or whiskey in a teaspoonful of water may be given at short intervals in order to stimulate heart action. The legs and the body may also be raised so as to insure the flow of blood into the head.

346. Vertigo is "a rush of blood to the brain." The body should be placed in a sitting posture, with the head erect, so as to draw the blood down. It may result from the rupture or bursting of a blood vessel in the brain itself, which may or may not be accompanied by apoplexy, shown by the helpless condition of an arm or a leg. The doctor should be called as soon as possible.

347. The treatment in all hemorrhages is: (a) stop the bleeding; (b) clean the wound in order to prevent infection; (c) dress the wound so that the tissues can grow together; (d) relieve the other symptoms.

348. Nature stops the bleeding by causing the blood to coagulate, due to the protein in the blood. This coagulation occurs

first in the capillaries, next in the veins, and last of all in the arteries. Bleeding from the capillaries may be stopped by firm pressure applied directly to the wound. If that does not suffice, then application of hot water, or a piece of ice, will tend to prevent the flow of blood due to the contraction of the vessel. If the bleeding is from a vein, then the pressure applied should be much stronger and for a little time. A handkerchief rolled up, wet thoroughly, and bound firmly over the wound will tend to prevent the flow of blood until the blood, of its own accord, will clot sufficiently. If the artery from which the blood is pouring is a small one, the pressure applied as above will usually suffice; but in the cases of larger arteries, where the blood is being pumped through by the heart, various other measures must be taken. The beating of the heart must, of course, not be retarded. Pressure should be applied by means of the tourniquet or "Spanish windlass," which will effectively cut off the flow of blood. If an artery in the scalp is cut, then firm pressure over and around the wound will always control it.

349. A broken bone is called a *fracture*; a bone out of its joint is called a *dislocation*. When, in addition to the fracture, the broken end of a bone protrudes through the latter, we speak of it as a *compound fracture*. The symptoms of a fracture are: pain and inability to move the affected limb; if the leg be broken at any point the patient will be unable to stand upon it.

The symptoms of a dislocation are: altered shape of the limb; inability to move it; great pain in and about the joint upon the slightest attempt at motion.

350. A person with a fracture may, without suffering harm, wait several hours and even a day for the "setting" of the bone. Rest and support of the injured member are the two things needed. First remove all clothing from the arm or leg, best by slitting the garments open, and not by pulling them off; then firmly tie a strip of wood on either side of the limb, protecting the skin by padding the wood well with anything soft, cotton or pieces of clothing. A pillow tied firmly around the arm or leg is a good support. Should some hours have to elapse before the surgeon arrives, the limb should be inspected from time to time to see that the cords are not tied too tightly.

351. Aid in dislocation lies chiefly in the proper support of

the limb in the position in which it is found. After the patient is at rest, place it in the position which proves the most comfortable for the sufferer, supporting it on either side. Cold water compresses to the joint will feel most restful.

352. A sprain is a severe straining or tearing of the ligaments surrounding a joint. In the milder forms these are only greatly stretched, but in the more severe cases they are torn entire or in part. See 142.

The best immediate relief that can be given is to place the joint in hot water, as hot as can be borne, and keep it there for several hours, or until the doctor arrives, changing the water as it cools. Should medical aid not be obtainable, then take the limb out of the hot water after two hours, and bandage it firmly, well below and above the joints, so as to give the greatest support and prevent all motion.

353. The secret of the best treatment of these injuries is to exclude the air from the wounded surfaces. When they are slight, and the skin is merely blistered, prevent the displacement of the skin as much as possible. Let the blisters be punctured, if necessary, to let out the liquid, and then keep the skin in place by cotton cloth or lint, wet with a solution of one teaspoonful of carbolic acid in a quart of water, or a strong solution of baking soda. The cloth should be kept wet constantly, but do not irritate the wound by taking off the dressing too often.

Extensive burns are much worse than deep burns. In the former case, the outlook is grave, and the patient will probably require the best aid, both medical and surgical.

354. (a) Asphyxia signifies an absence of pulse due to the non-conversion into arterial blood of the venous blood. The supply of fresh air to the lungs being cut off by some cause the necessary purification does not take place, and death may occur immediately. In other words, an asphyxiated person dies because the blood is not purified. (b) The several varieties of asphyxiation are: (1) as in drowning; (2) in strangulation; (3) in suffocation; (4) in toxic poisoning.

355. Illuminating gas is dangerous in two ways. If it escapes into a tightly closed room in sufficient quantities, it may cause the death of the inmates by suffocation. If not too late, remove

the patient into fresh air, undo the clothing, dash cold water on the face and neck, and employ artificial respiration. If gas escapes freely into an apartment, it forms an explosive compound by mixing with the air. If then a light is unguardedly taken into the place, an explosion that may be destructive to life will result. Always thoroughly air any room that has the odor of escaping gas before a light is taken in.

356. Keep away from the fire and in a cool room. Rub the nose, or other part that has been "bitten," with snow or ice-water until the blood is warmed again and circulating in the part.

357. Sunstroke is seldom produced in this climate in persons who have not labored too hard, or indulged in alcoholic drinks. On very hot days avoid fatigue and open-air labor as much as possible. Keep the head cool. If any unusual, dizzy feeling comes on, apply cold water to the head and neck. If a person falls unconscious, and the skin is decidedly hot and dry, he should be taken to a cool place. If the face and head are red and hot, apply cloths wet with iced water. If pale, give stimulants gradually, and use cold water sparingly.

358. If the patient is a young woman, the attack is probably hysterical, and a sprinkle of cold water will bring relief. If the patient struggles and there is bloody froth on the lips, it is a case of epilepsy. Meanwhile, protect the head from injury by putting a pillow or some soft article beneath it; a handkerchief introduced between the teeth will prevent the biting of the tongue. Prevent the person from falling or injuring himself, but do not attempt to forcibly hold him quiet.

In children, apply cloths dipped in water to the head; disturb the child as little as possible; do not use a warm bath until directed by the doctor.

359. As soon as the body is recovered from the water, turn it over, face and head downward for a moment, and thrust a finger backward into the mouth in order to depress the tongue forward. This is done in order to give a clear passage for the air to the lungs. The body should be stripped, if possible, and wrapped in blankets or some other dry coverings, and the body extremities and other regions warmed by patting or warm applications. Resort to artificial breathing by either the Sylvester or the

Marshall Hall method. Marshall Hall Method: The patient is placed flat on his face; gentle pressure is then applied to the back, the pressure removed, and the body turned on the side. The body is again turned on the face; gentle pressure is again applied to the back, and the body again turned on the side. This should be done about sixteen times a minute.

360. (a) A poison is "any substance which, when introduced into the system, or applied externally injures health, or destroys life irrespective of mechanical means, or direct thermal changes."

(b) Whatever the poison may be, the treatment is: (1) To get the poison out of the body by inducing vomiting; (2) To neutralize, by means of antidotes, what cannot be removed. (3) To combat any dangerous symptoms that have arisen, and to neutralize their effects by means of stimulants, artificial respiration, and exciting the action of the skin, kidneys, and bowels.

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